Quaternary Geology, Geomorphology, and Climatic History of Kane County, Illinois

Geological Field Trip 3: April 24, 1999

B. Brandon Curry, David A. Grimley, and Jay A. Stravers

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615 East Peabody Drive
Champaign, IL 61820-6964
(217) 333-4747
http://www.isgs.uiuc.edu

Cover photo *Black-and-white image of color infrared aerial photograph of the area southwest of Elburn, Illinois, showing textures of three types of surficial deposits: pockmarked fan-delta; dark and featureless lake plains; and mottled hummocky (morainic) topography. Stops 3 (the Feltes pit), 4 (the Fisherman's Inn), and 5 (Prairie pit) are located on the map.*

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B. Brandon Curry, David A. Grimley
Illinois State Geological Survey

Jay A. Stravers
Northern Illinois University

contributions by

Eric C. Grimm,
Illinois State Museum

Kathi L. Hibben
Northern Illinois University

Matthew Barner and Michael D. Guebert
Wheaton College

Ardith K. Hansel
Illinois State Geological Survey

Mary Ochsenschlager
St. Charles Park District

Richard G. Baker
University of Iowa

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Illinois State Geological Survey
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1301 West Green Street
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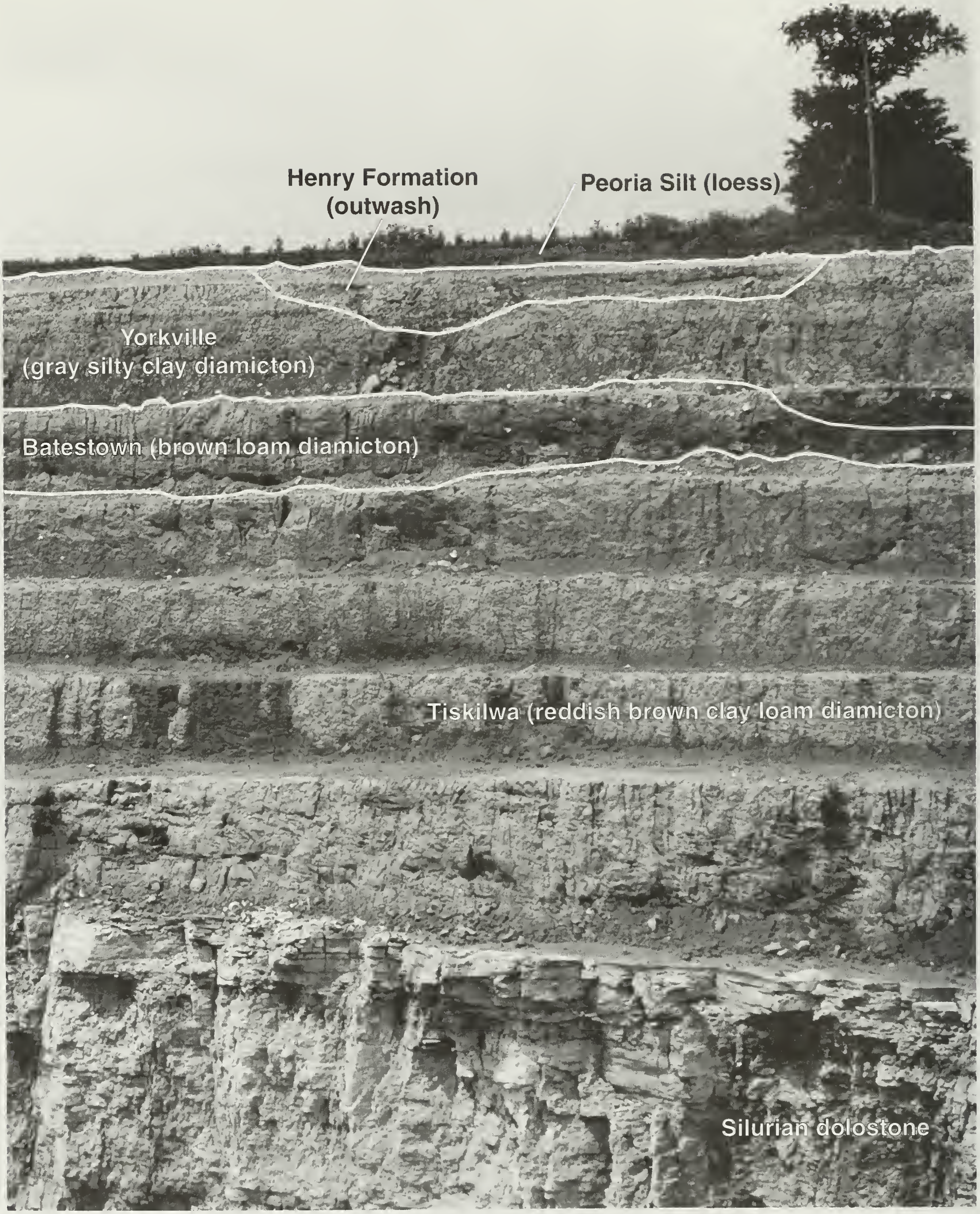
U.S. Geological Survey, Water Resources Division
221 North Broadway Avenue
Urbana, IL 61801



An 80-foot-high exposure at the Fox River Stone quarry (Stop 1) of Silurian dolostone and three diamicton units of the last glaciation (Tiskilwa Formation, Batestown Member of the Lemont Formation, Yorkville Member of the Lemont Formation, Henry Formation, and Peoria Silt).

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INTRODUCTION

As a collar county of Chicago, Kane County has recently undergone tremendous growth. In 1996, the population in Kane County was 370,361, and it is projected to grow to about 540,000 by the year 2020 (Kane County Regional Planning Commission 1996). The north–south-trending Fox River valley has been a natural corridor of urban development along which are found the largest and oldest communities in the county, such as Aurora, Elgin, St. Charles, Batavia, and Geneva (inside back cover). These communities obtain part or all of their municipal water from groundwater contained in Quaternary sand and gravel aquifers found primarily in buried bedrock valleys (Curry and Seaber 1990).

The geology of Kane County includes gently dipping Paleozoic sedimentary rocks that are covered by as much as 350 feet of Quaternary glacial sediment (Graese et al. 1988, Wickham et al. 1988). Kane County is a region of varied geomorphologic character. Like much of northeastern Illinois, Kane County has curvilinear moraines that were formed by active glacial ice, but the county also has numerous landforms such as kames and eskers that were formed by stagnant ice. During our field trip, we will examine deposits of both active and stagnant ice, sample fossils of hardy tundra plants and invertebrates that lived adjacent to the Lake Michigan Lobe, discuss the postglacial vegetation and paleohydrology, and consider the effects of mining on the depth of fish-stocked ponds.

Previous Investigations

The glacial geology of northeastern Illinois was first described by Leverett (1899). From the late 1920s to the 1970s, the Illinois State Geological Survey (ISGS) and graduate students periodically mapped the geology of Kane County at scales of 1:62,500 to 1:100,000 (Leighton et al. 1928–1930, Gross 1969, Gilkeson and Westerman 1976, Kempton et al. 1977, Masters 1978, Kemmis 1978, Wickham 1979, Wickham et al. 1988). The physical characteristics of glacial deposits were characterized by particle size distribution, clay mineralogy, clast lithology, and geophysical logging (Hackett and Hughes 1965, Lund 1965, Landon and Kempton 1971, Reed 1972, 1975, Kemmis 1981). The geology of Kane County was thoroughly investigated during efforts to site the U.S. Department of Energy's Superconducting Super Collider (SSC) in northeastern Illinois (Kempton et al. 1985, 1986, 1987, Curry et al. 1988, Graese et al. 1988, Vaiden et al. 1988). As an outgrowth of the SSC studies, digitized maps at a scale of 1:62,500 were published for bedrock topography (Vaiden and Curry 1990), drift thickness (Erdmann et al. 1990), stack-units (to a depth of 15 m, Curry 1990a), Tiskilwa Formation isopach (Curry 1990b), and other features. Recent hydrogeological investigations in Kane County have used seismic refraction, electrical earth resistivity surveys, test borings, and pump tests to characterize sediments and groundwater resources (Heigold 1990, Gilkeson et al. 1987, Larson and Orozco 1991, 1992, Larson et al. 1992a, b, Morse and Larson 1991). Today, the ISGS continues to map surficial deposits at a scale of 1:24,000 as part of the Statemap program (Curry, in review, Grimley, in review, Grimley et al., in review b).

Bedrock Geology

Gently dipping and undeformed Paleozoic dolomite, limestone, and shale immediately underlie glacial deposits of this region (figs. 1 and 2). The pattern of Paleozoic units at the bedrock surface resulted from postdepositional erosion and dip of the bedrock strata from about 0.1° to 0.2° to the southeast (Graese 1991).

Above the generally thickly bedded dolostones of the Galena and Platteville Groups are the more thinly bedded dolostones, minor limestones, and shales of the Maquoketa Group. The full thickness of the Ordovician Maquoketa Group in eastern Kane County is about 210 feet (Graese 1991). More than 100 feet thick in places, Silurian dolomite covers slightly more than half the county's bedrock surface (fig. 2).

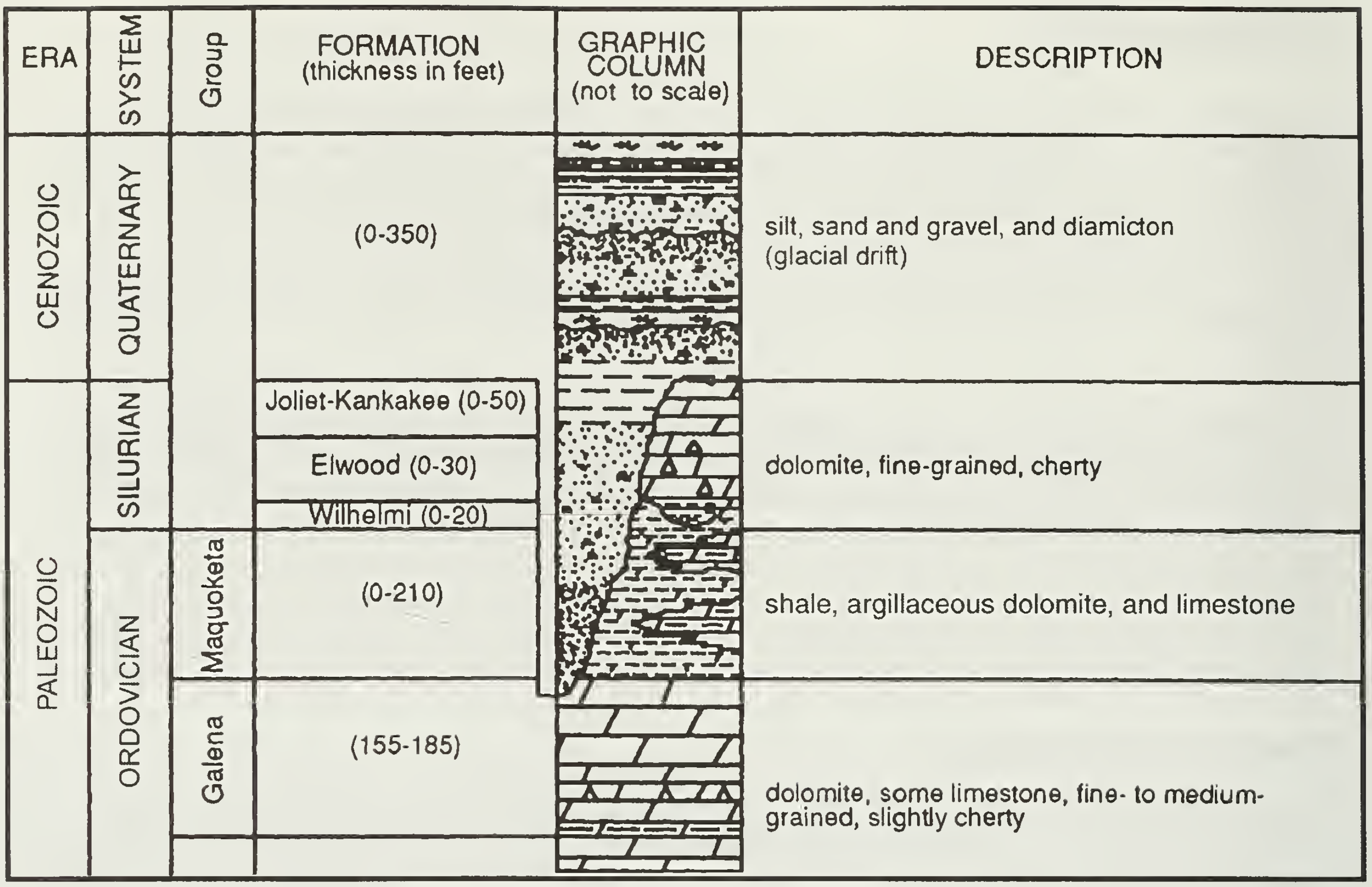


Figure 1 Simplified bedrock stratigraphy of Kane County (modified from Graese 1991).

BEDROCK TOPOGRAPHY AND DRIFT THICKNESS

The gently sloping bedrock highlands in Kane County are cut by sinuous, steep-walled bedrock valleys (fig. 3); maximum relief is about 350 feet. Fluvial and glaciofluvial sand and gravel deposits in the bedrock valleys are important aquifers in Kane County (Curry and Seaber, 1990). The St. Charles Bedrock Valley, the largest buried bedrock valley in this region, heads near the city of Elgin, crosses beneath the Fox River near St. Charles, and exits Kane County to the south and west (fig. 3). Drift thickness in Kane County ranges from nil (where bedrock is exposed along the Fox River and its tributaries) to more than 300 feet under the highest part of the Marengo Moraine (fig. 4).

QUATERNARY GEOLOGY

The following discussion is based largely on our geologic mapping (fig. 5), interpretation of surficial or buried landforms, sedimentological studies at natural and manmade outcrops, and radiocarbon ages. Although the Lake Michigan Lobe sporadically invaded northeastern Illinois during the pre-Illinois and Illinois Episodes from about 700,000 to about 125,000 yr B.P. (Curry and Pavich 1996), we will begin our Quaternary history with the Sangamon Episode (fig. 6).

Quarternary History

Sangamon Episode (≈125,000 to 55,000 year ago) The last interglaciation, known as the Sangamon Episode, was marked by weathering and formation of the Sangamon Geosol (fig. 6). Soil devel-

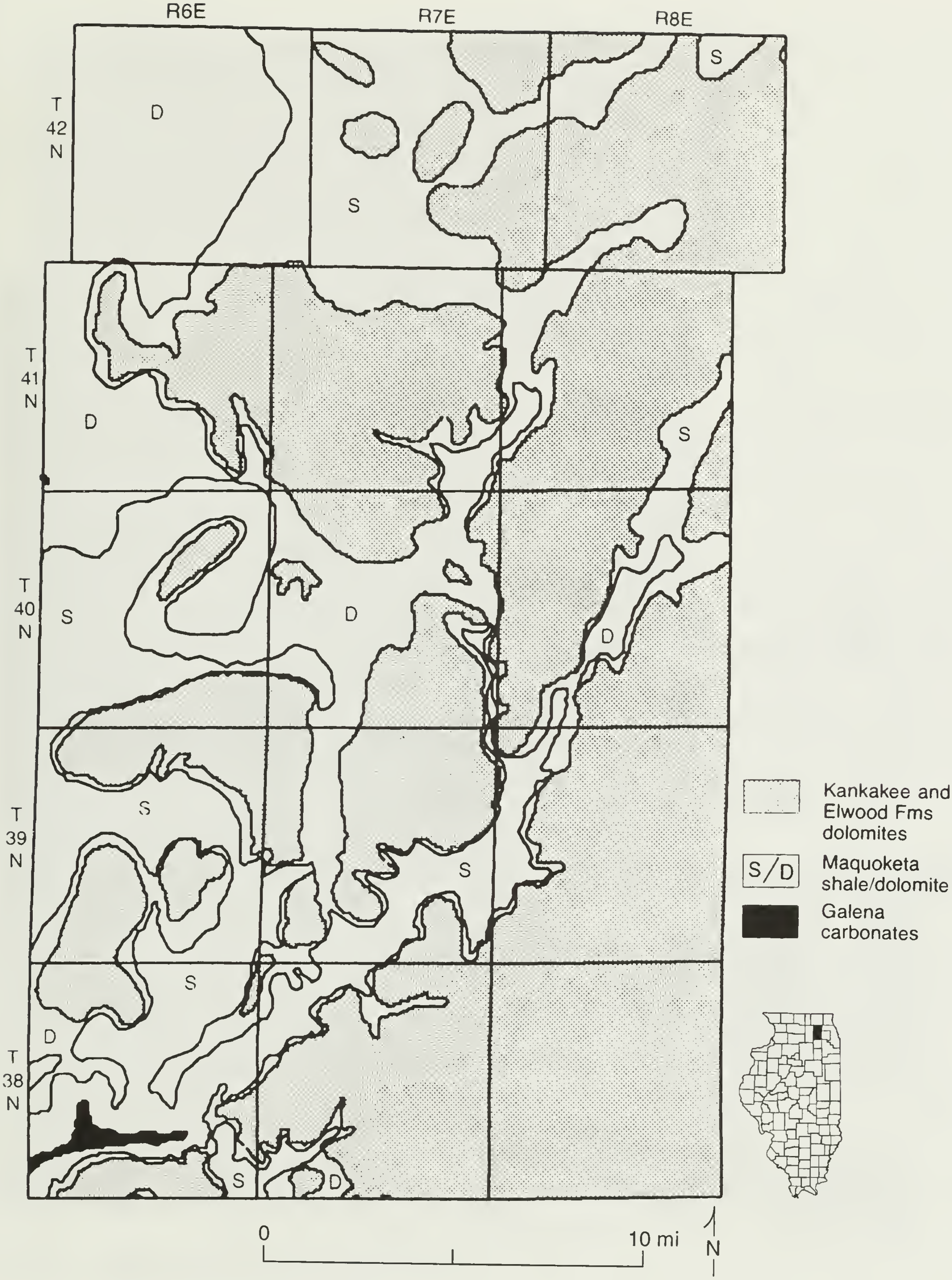


Figure 2 Paleozoic rock units at the bedrock surface (after Graese 1991).

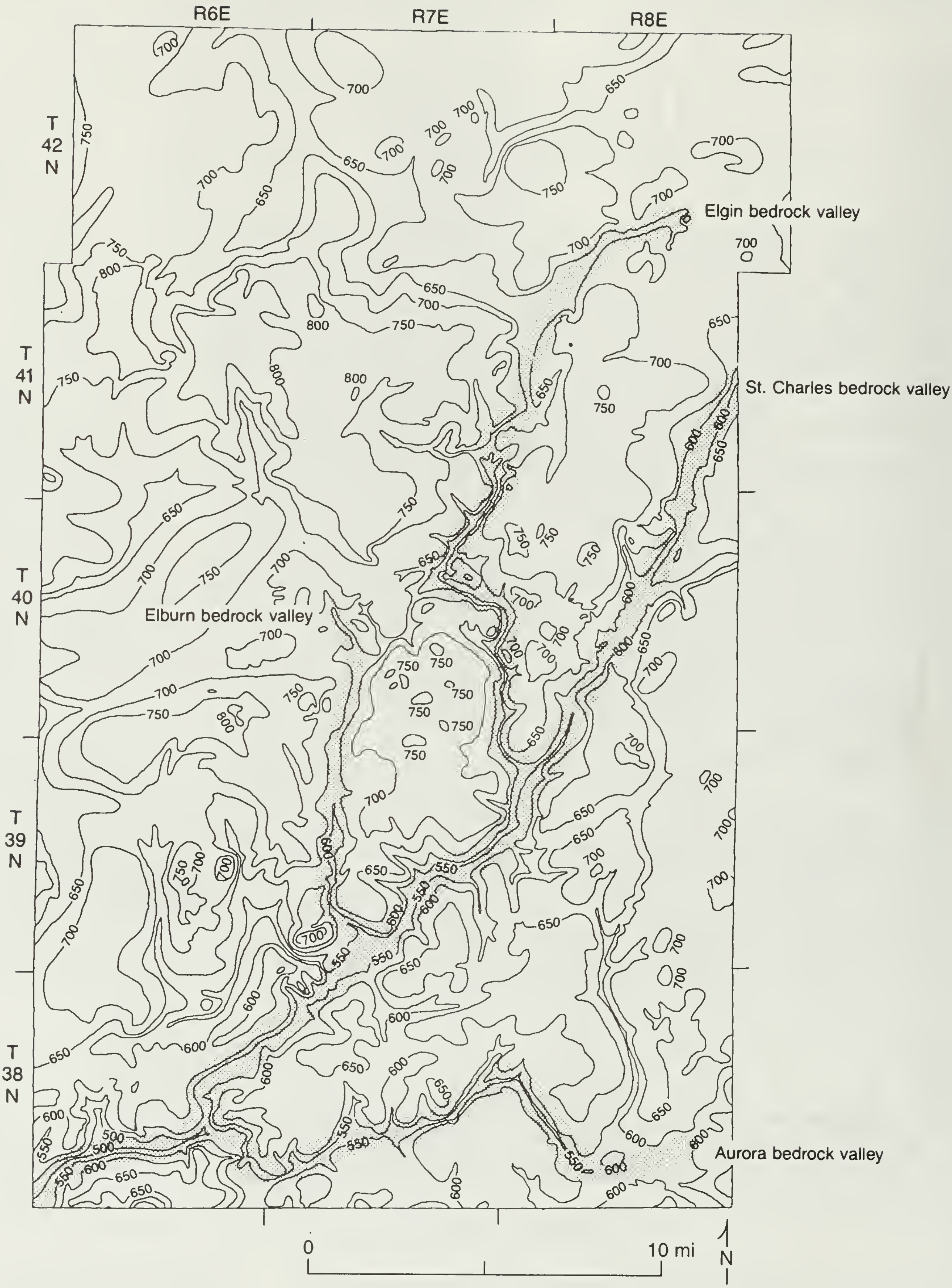


Figure 3 Buried bedrock topography. Stippled pattern indicates the major bedrock valleys (from Vaiden and Curry 1990).

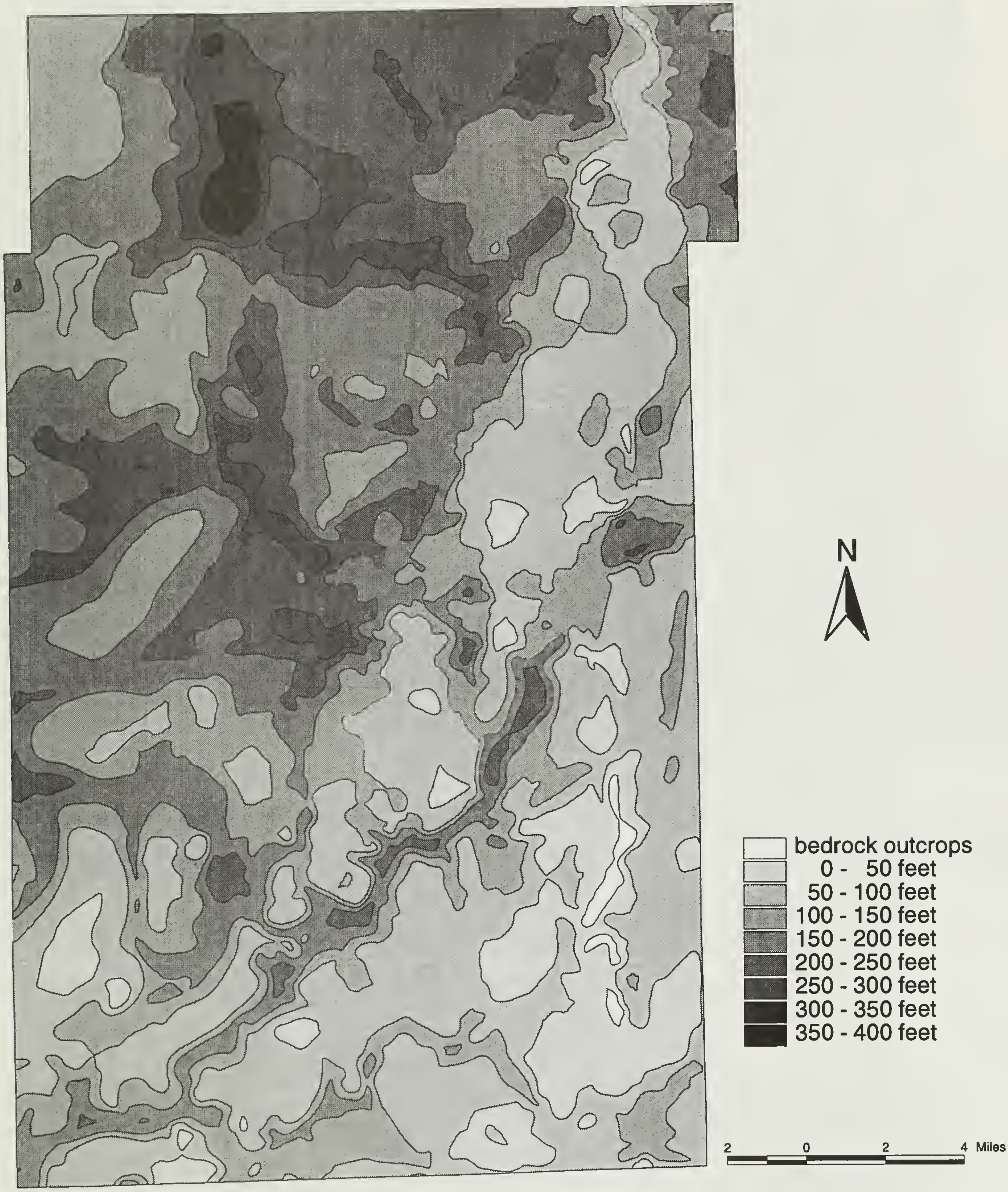


Figure 4 Drift thickness (from Erdmann et al. 1990).

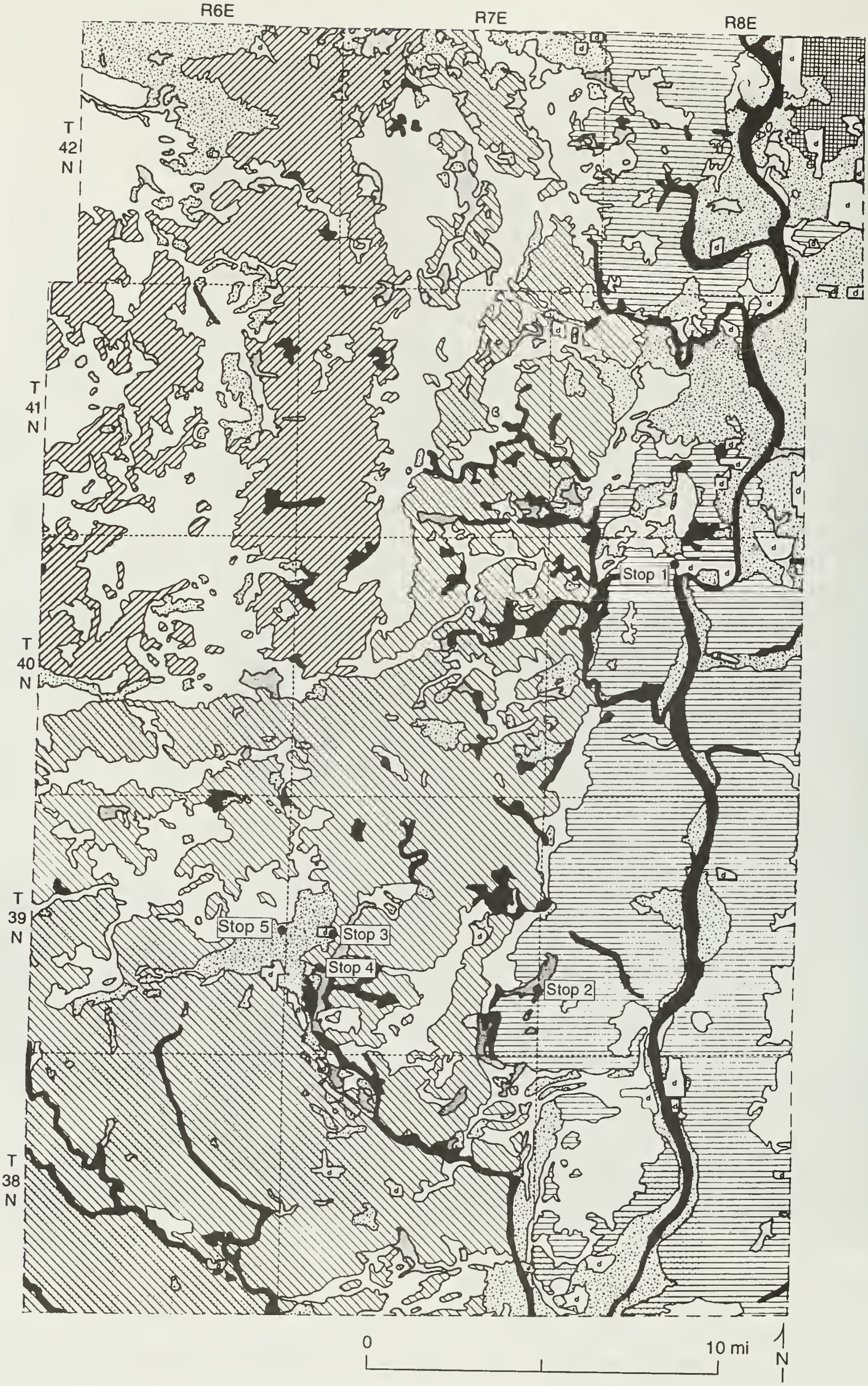


Figure 5a Surficial geology (from Curry and Seaber 1990).

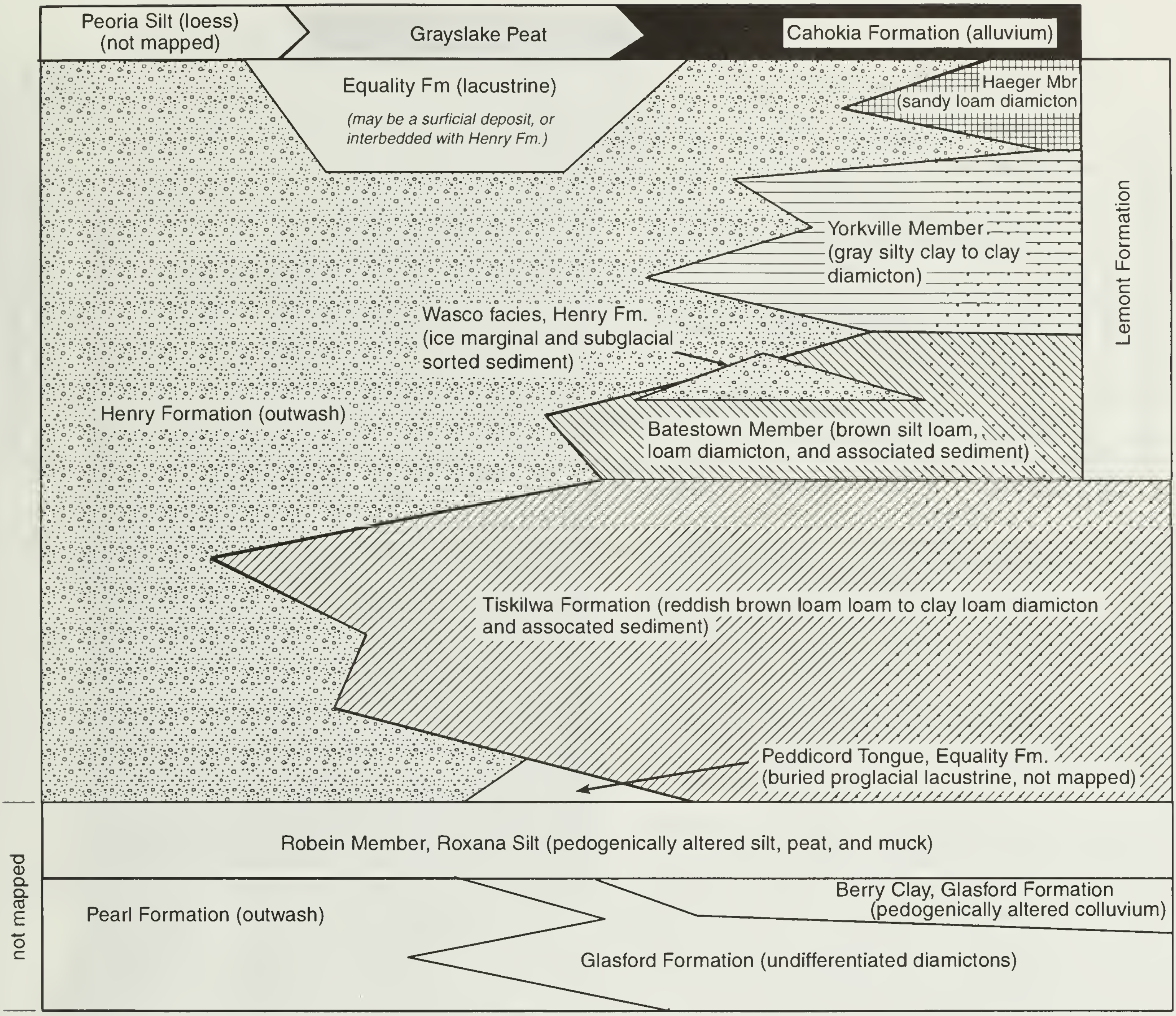


Figure 5b Stratigraphic relationships among the Quaternary lithostratigraphic units and key for figure 5a.

opment probably occurred under several climatic regimes and vegetation types ranging from prairies to deciduous forests (Curry and Baker 1998, Curry and Baker, in press, Dorale et al. 1998). A poorly drained facies of the Sangamon Geosol will be examined at Stop 3 (the Feltes sand and gravel pit).

Athens Subepisode, Wisconsin Episode (≈55,000 to 25,000 yr B.P.) Prior to invasion by ice during the last glaciation, northern Illinois was covered with lakes and open spruce forests (Meyers and King 1985). In Kane County, less than 3 feet of medium-silt- and fine-silt-rich loess was deposited. The loess has been weathered throughout, and is the Robein Member of the Roxana Silt (figs. 5b and 6). The oldest loess was primarily incorporated through bioturbation into the upper Sangamon Geosol; the youngest loess commonly contains abundant organic matter and, in some places, rooted spruce trees (Stop 3). The ultimate glacial source of the loess was located in the Mississippi River basin north of Illinois (Curry 1989).

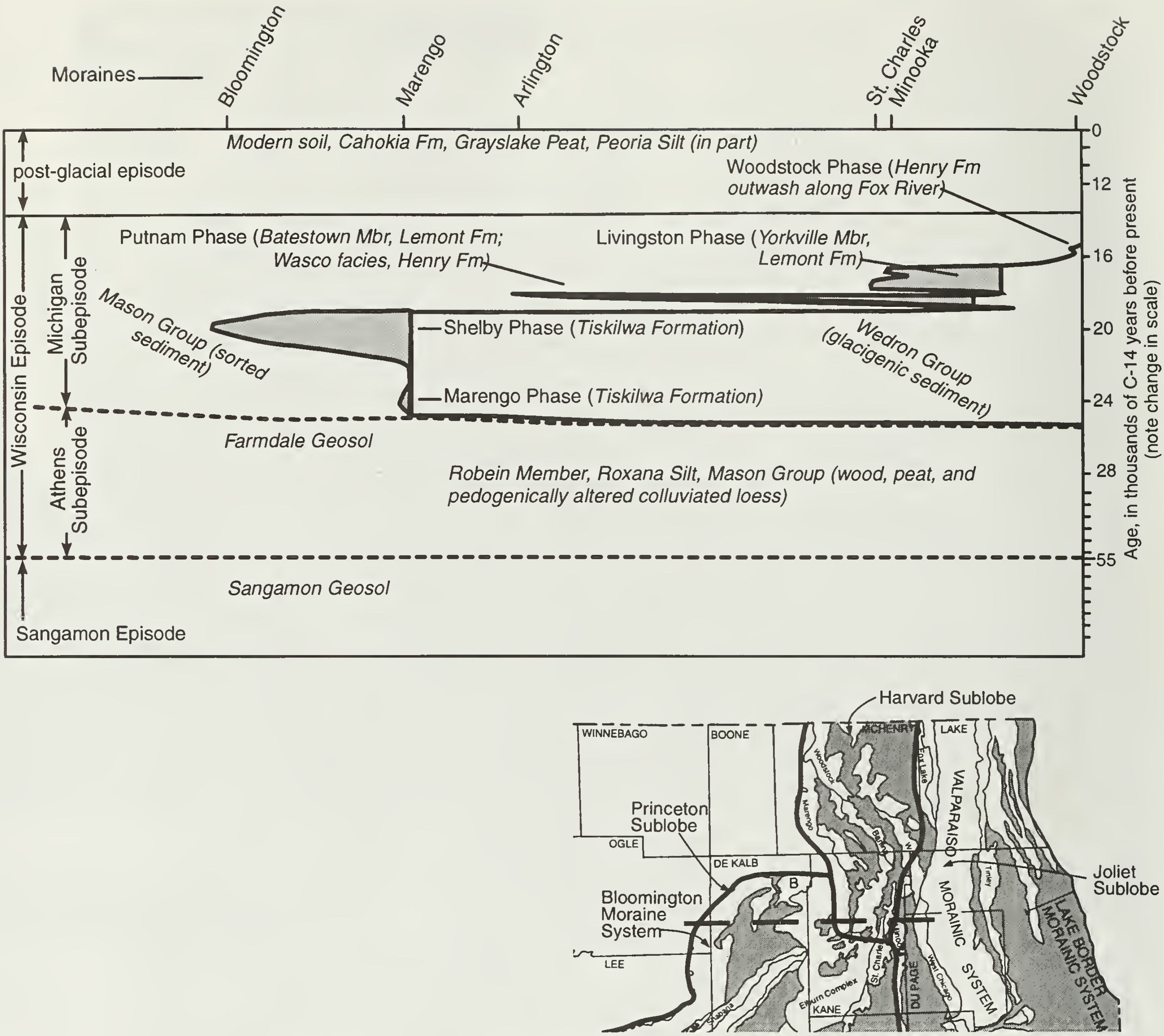


Figure 6 Schematic time-space diagram for the Lake Michigan Lobe in northeastern Illinois. Inset shows the location of the Harvard, Princeton, and Joliet Sublobes of the Lake Michigan Lobe (after Willman and Frye 1970); dashed line shows the line of section.

Marengo Phase, Michigan Subepisode (≈25,000 to 22,500 yr B.P.) The earliest glacial deposits of the last glaciation (Michigan Subepisode) include near-glacial lacustrine sediment and outwash. These sediments were overridden during the Marengo Phase by the westward-flowing Harvard Sublobe, which deposited diamicton and sorted sediment of the Tiskilwa Formation (figs. 5, 6, and 7). The Marengo Moraine was formed during this phase.

Shelby Phase, Michigan Subepisode (≈22,500 to 18,000 yr B.P.) After the Marengo Moraine was formed, the Princeton Sublobe flowed northwest into Kane County, deposited additional Tiskilwa Formation, and formed the Bloomington Morainic System (figs. 5 and 7). Evidence at the

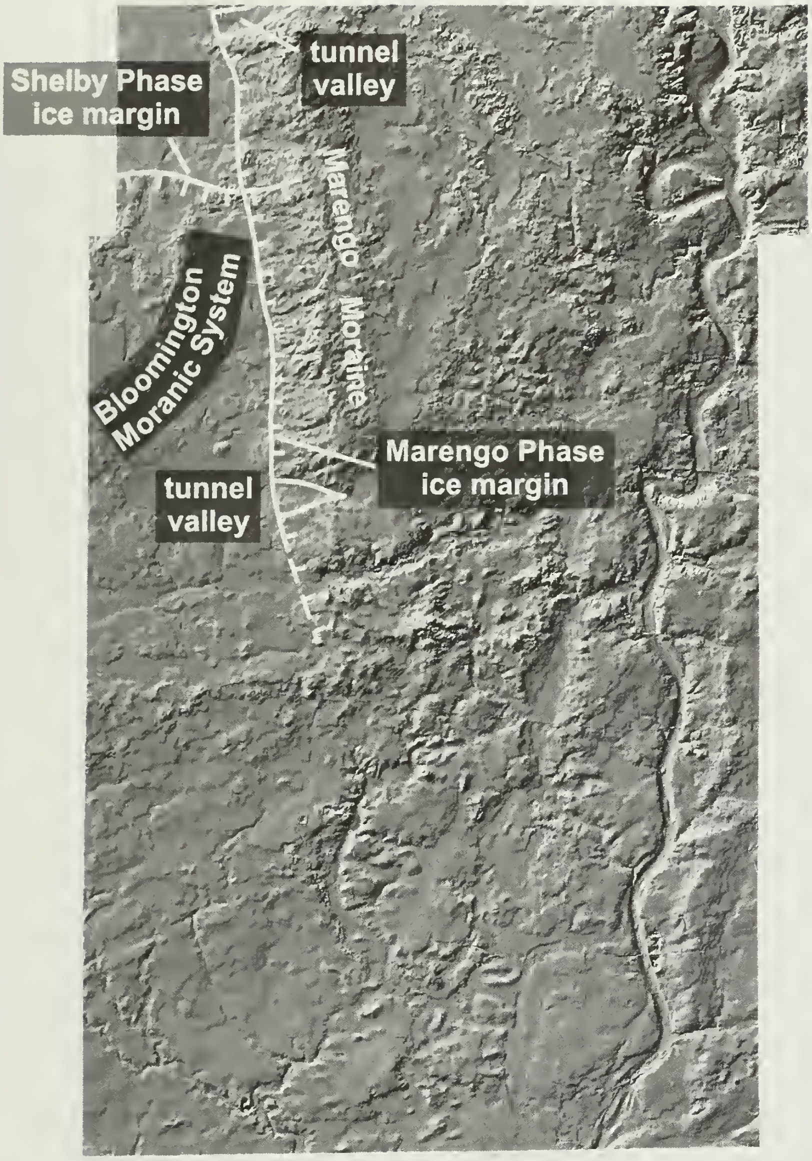


Figure 7 Maximum extent of ice margin during the Marengo Phase (≈25,000 to 22,500 yr B.P.) and the Shelby Phase (≈22,500 to18,000 yr B.P), and tunnel valleys associated with the Marengo Moraine. The map base is a shaded relief map of Kane County (McGarry et al. 1999).

Feltes and Prairie pits (Stops 3 and 5) indicates that between the Marengo and Shelby Phase advances, the ice in the Harvard Sublobe stagnated.

Putnam Phase, Michigan Subepisode (≈18,000 to 17,500 yr B.P.) After melting back to approximately eastern Kane County, the Princeton and Harvard Sublobes readvanced and coalesced in central Kane County (figs. 6 and 8). Large proglacial lakes formed, such as Glacial Lake Pingree (fig. 8), which was dammed by the Marengo Moraine and Bloomington Morainic System to the west and south, and by glacial ice to the east and north (Curry et al. 1997). Landforms attributed to stagnant ice (such as kames, the Kaneville esker, and its related fan-delta) also formed in Kane County during the Putnam Phase. The stagnant-ice features and deposits contrast with the active-ice morainic ridges typical of the earlier Shelby and Marengo Phases and later Livingston Phase. Glacial diamicton and intercalated sorted sediment deposited during the Putnam Phase constitute the Batestown Member of the Lemont Formation (fig. 5).

Livingston Phase, Michigan Subepisode (≈17,500 to 16,000 yr B.P.) After the coalesced Princeton and Harvard Sublobes retreated to near the present Fox River, the Joliet Sublobe readvanced to the position of the St. Charles Moraine during the Livingston Phase (figs. 6 and 9). During the early part of this phase, Nelson Lake formed, and ice-marginal streams deposited valley-train sand and gravel west of the St. Charles Moraine. Diamicton deposited during the Livingston Phase is the Yorkville Member of the Lemont Formation (fig. 5).

South of the Fox River Stone quarry (Stop 1), the Fox River valley began to form as an ice-marginal stream when the ice retreated and formed the Minooka Moraine during the latter part of the Livingston Phase (figs. 6 and 10). During this time, an alluvial fan and fossiliferous lacustrine sediment was deposited in a low area on the St. Charles Moraine at the Fox River Stone quarry. During the late Livingston Phase, the ice margin retreated to as far east as about the West Chicago Moraine, east of Kane County.

Woodstock Phase, Michigan Subepisode (≈16,000 to 15,500 yr B.P.) During the Woodstock Phase, the Harvard Sublobe formed the Woodstock Moraine, the lower part of the West Chicago Moraine, and associated outwash plains in northeastern Kane County (fig. 6). Large volumes of meltwater modified the landscape, both eroding channels and depositing dolostone-rich outwash.

The valley of the Fox River north of the bend east of the Fox River Stone quarry formed during this phase, as well as the large abandoned meander scar north of Elgin, large strath terraces and gravelly point bars, and several channels that cut across the Minooka Moraine and St. Charles Moraine (fig. 11). Equality Formation was deposited in slackwater lakes formed behind outwash dams at the mouths of valleys tributary to the Fox River. Woodstock Phase deposits include glacigenic diamicton of the Haeger Member of the Lemont Formation and associated sand and gravel of the Henry Formation (fig. 5).

Other glacial phases After the Woodstock Phase, the ice margin retreated rapidly to near the Milwaukee area during the Milwaukee Phase (≈15,500 to 15,000 yr B.P.) (Hansel and Johnson 1992). The final glacial advance that directly affected Kane County occurred during the Crown Point Phase (≈15,000 to 14,000 ys B.P.), when the Joliet Sublobe readvanced to just east of Kane County and deposited the Wadsworth Formation and formed the Valparaiso Morainic System (Hansel and Johnson 1992). Although little glacial sedimentation occurred during the Crown Point Phase in Kane County, much meltwater flowed down the Fox River valley as the ice slowly melted in eastern McHenry County and Lake County.

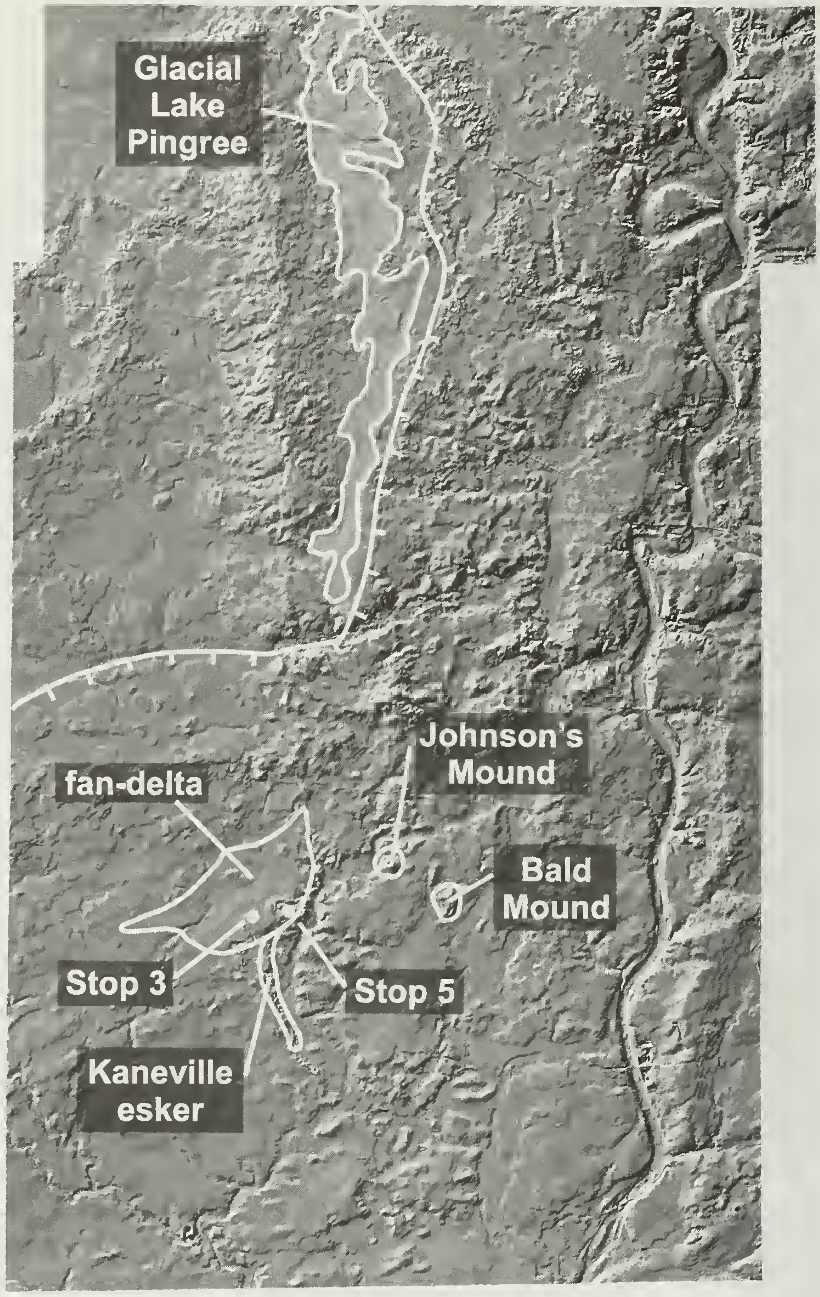


Figure 8 Maximum extent of ice margin during the Putnam Phase (≈18,000 to 17,500 yr B.P.) and features formed during the Putnam Phase. Hachured line indicates ice margin.

Late glacial and postglacial episodes (≈15,000 yr B.P. to the present) The phases discussed below represent pollen zones (biozones) of a 50-foot-long core taken from the center of Nelson Lake, the longest Holocene-late glacial record from northern Illinois (fig. 12). Five AMS radiocarbon ages (table 1) provide chronology. Additional radiocarbon ages will be necessary to ascertain changes in sediment accumulation rates and possible hiatuses. For example, the age near the top of the spruce (*Picea*) zone of 12,345 ± 95 yr B.P. appears to be too old by about 2,000 years. Based on other sites in the region, such as Volo Bog (King 1981), Lima Bog, and Devils Lake (Baker et al. 1992), the age of the spruce decline should be about 10,000 yr B.P. Either the dated *Picea* fragments were redeposited or a hiatus exists in the core at the top of zone 2.

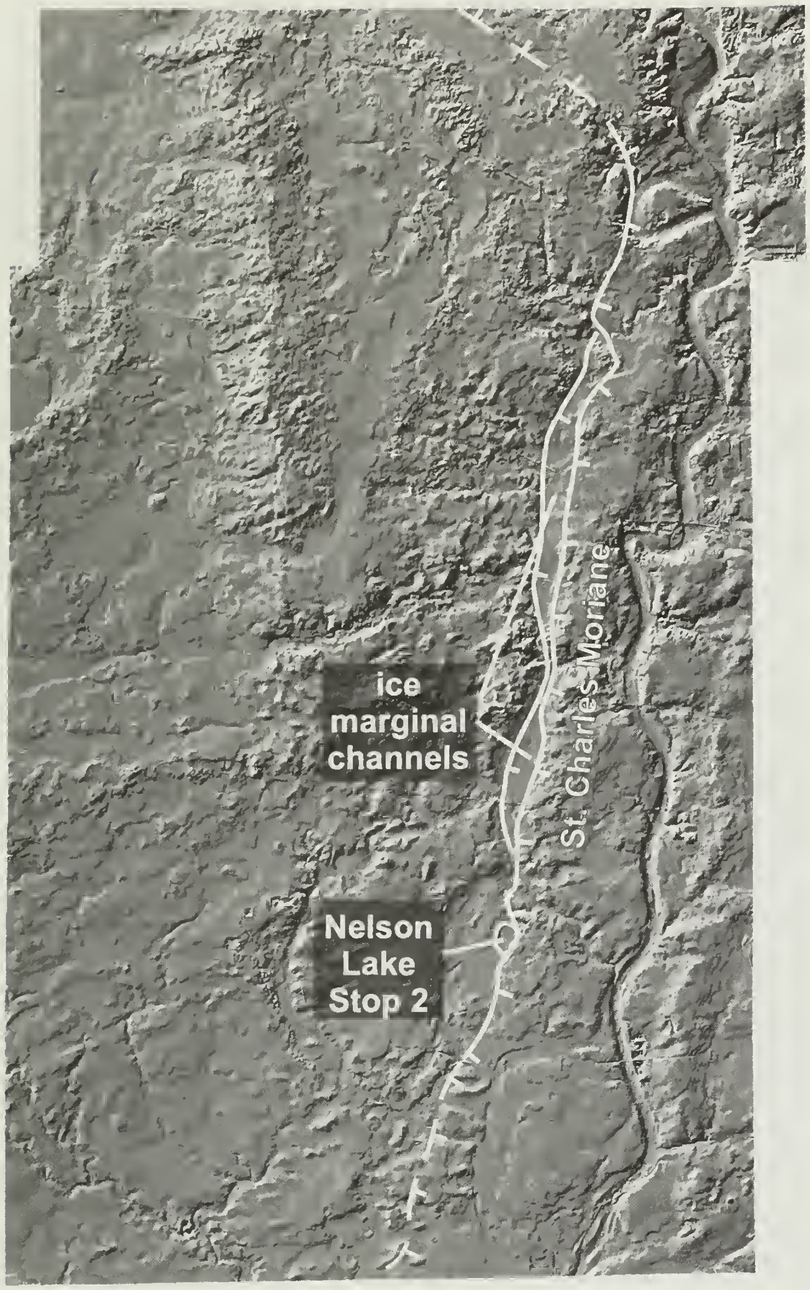


Figure 9 Maximum extent of glacial ice and ice-marginal drainage during formation of the St. Charles Moraine during the early Livingston Phase (≈17,500 to 16,000 yr B.P.). The location of Nelson Lake (Stop 2) is shown. Hachured line indicates ice margin.

The paleohydrology of Nelson Lake is interpreted from an ostracode record (fig. 12). Ostracodes are microcrustaceans that are sensitive to their aquatic environment with respect to water depth, solute chemistry, solute concentration (Forester 1987), and other factors (Curry, in press).

The ***late glacial sedge phase*** (≈15,000 to 13,500 yr B.P.) is represented by high sedge (Cyperaceae) and moderate spruce (*Picea)* percentages, and some grass (Poaceae) and sage (*Artemisia;* fig. 12; zone 1). The vegetation was forest-tundra, mostly open, with scattered trees or clumps of spruce. Nelson Lake supported female *Limnocythere friabilis* (fig. 13), an ostracode that is not common today, but is found in the cool to cold waters of large, deep lakes such as Lake Michigan (Buckley 1975) and in shallow lakes in northern Canada (Delorme 1971). The presence of *L. friabilis* and absence of other species suggests that the water had high rates of evaporation and/or significant groundwater inflow relative to overland flow.

The ***late glacial spruce phase*** (≈13,500 to 10,000 yr B.P.) is represented by high percentages of spruce (*Picea)* pollen, and moderate amounts of larch *(Larix,* a poor pollen producer) and some black ash pollen (*Fraxinus nigra*-type; fig. 12, zone 2). Herb pollen percentages are low. Vegetation was a closed spruce-larch forest with black ash. Although generally boreal in nature, the pollen assemblage differs from the modern boreal forest in the absence of pine and the presence of ash. The assemblage probably represents a climate with cool summers favoring spruce and larch, but with winters warmer than the modern boreal forest. The ostracode assemblage consists of *Cytherissa lacustris*, *Candona rawsoni*, and *Candona ohioensis* (fig. 13); this assemblage is found today in lakes of the mixed-forest region of north-central Minnesota where precipitation exceeds evaporation (Smith 1991). The presence of *Cytherissa lacustris* implies dilute water and more precipitation than evaporation.

The ***late glacial–post glacial transition phase*** (≈10,000 to 9,000 yr B.P.) includes declining spruce *(Picea)* percentages and peaks in fir (*Abies)*, balsam poplar (*Populus balsamifera*-type), black ash (*Fraxinus nigra*-type), birch (*Betula*), and alder (*Alnus incana*-type; fig. 12, zone 3). A secondary peak in spruce may represent the Younger Dryas period, but additional radiocarbon ages are needed for verification. A peak in *Picea* coeval with the Younger Dryas of Europe occurs in records throughout the lower Great Lakes region (Shane 1987, Shane and Anderson 1993). Ironwood (*Ostrya*-type), elm (*Ulmus*), and oak (*Quercus*) percentages rise during this phase. The ostracode assemblage also is transitional and includes the species deposited during the prior phase as well as small numbers of *Cypridopsis vidua* and *Candona acuta*.

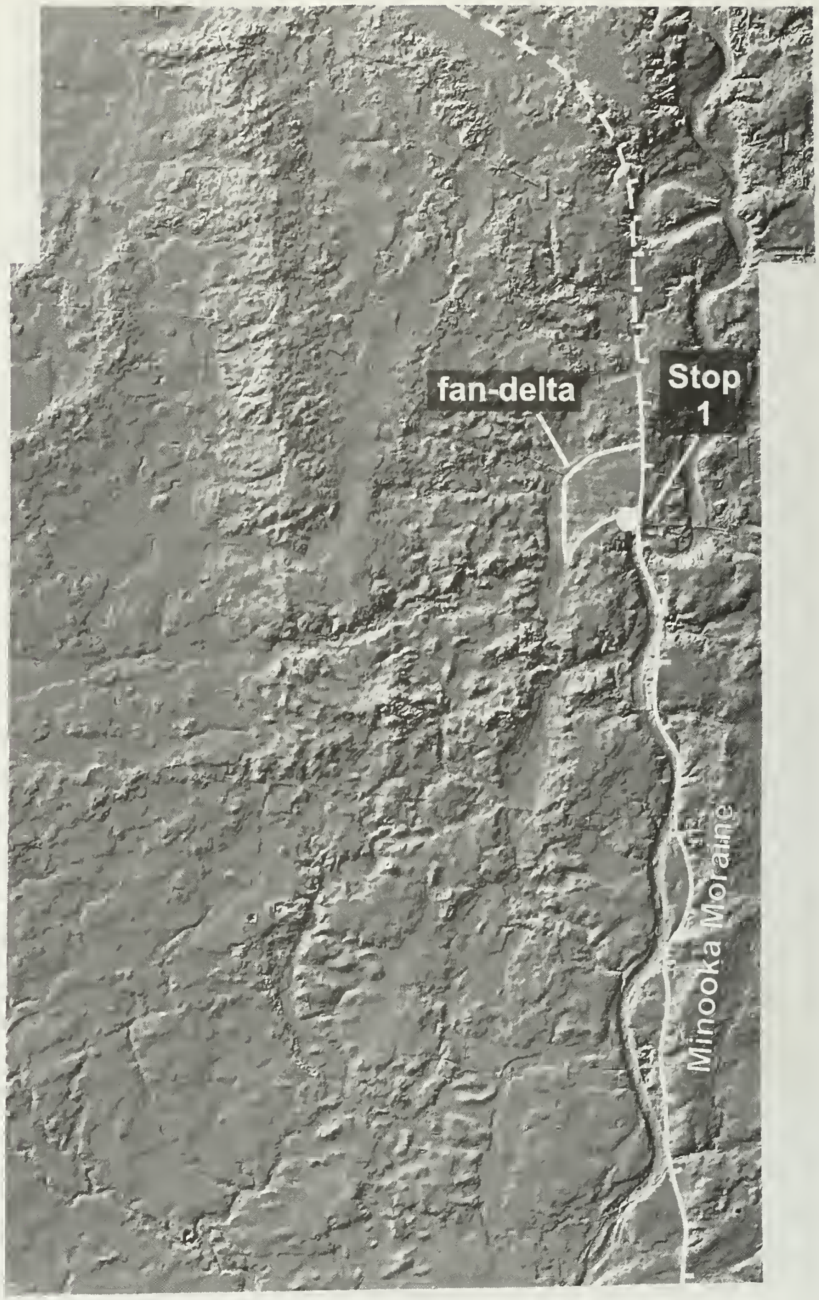


Figure 10 Maximum extent of glacial ice and fan-delta (Stop 1) associated with formation of the Minooka Moraine during the late Livingston Phase (≈17,500 to 16,000 yr B.P.). Hachured line indicates ice margin.

The ***postglacial deciduous phase*** (≈9,000 to 5,500 yr B.P.) is represented by high percentages of deciduous trees, including ironwood (*Ostrya*-type), elm (*Ulmus)*, oak (*Quercus)*, hickory (*Carya)*, and sugar maple (*Acer saccharum*), and increasing percentages of grass (Poaceae) and ragweed (*Ambrosia*-type; fig. 12, zone 4). The high percentages of mesic deciduous trees (ironwood, elm, and sugar maple) indicate conditions moister than today. However, the increasing percentages of grass and ragweed pollen indicate expanding prairie openings. During this phrase, the perihelion was during the summer, and increased insolation may have enhanced the summer monsoon, raising soil moisture and favoring mesic trees. However, seasonal desiccation is probably indicated by the development of prairie openings, probably on upland surfaces. Moist climatic conditions during this phase are consistent with conditions at other sites in northeastern Iowa and southern Wisconsin (Baker et al. 1992, 1996).

The ***postglacial dry phase*** (≈5,500 to 3,000 yr B.P.) is marked by a decline in the percentages of mesic deciduous trees, which indicates conditions drier than during deposition of the postglacial deciduous phase (fig. 12, zone 5). Maximum percentages of sage (*Artemisia)* and goosefoot/amaranths (Chenopodiaceae/Amaranthaceae) in the lower part of this zone perhaps represent maximum dryness during postglacial time, which is consistent with maximum drought at Roberts Creek, northeastern Iowa, at this time (Baker et al. 1992, 1996). At Nelson Lake, deposition of sediment increased dramatically during this phase, which reflects inward growth or encroachment of the fringing wetland.

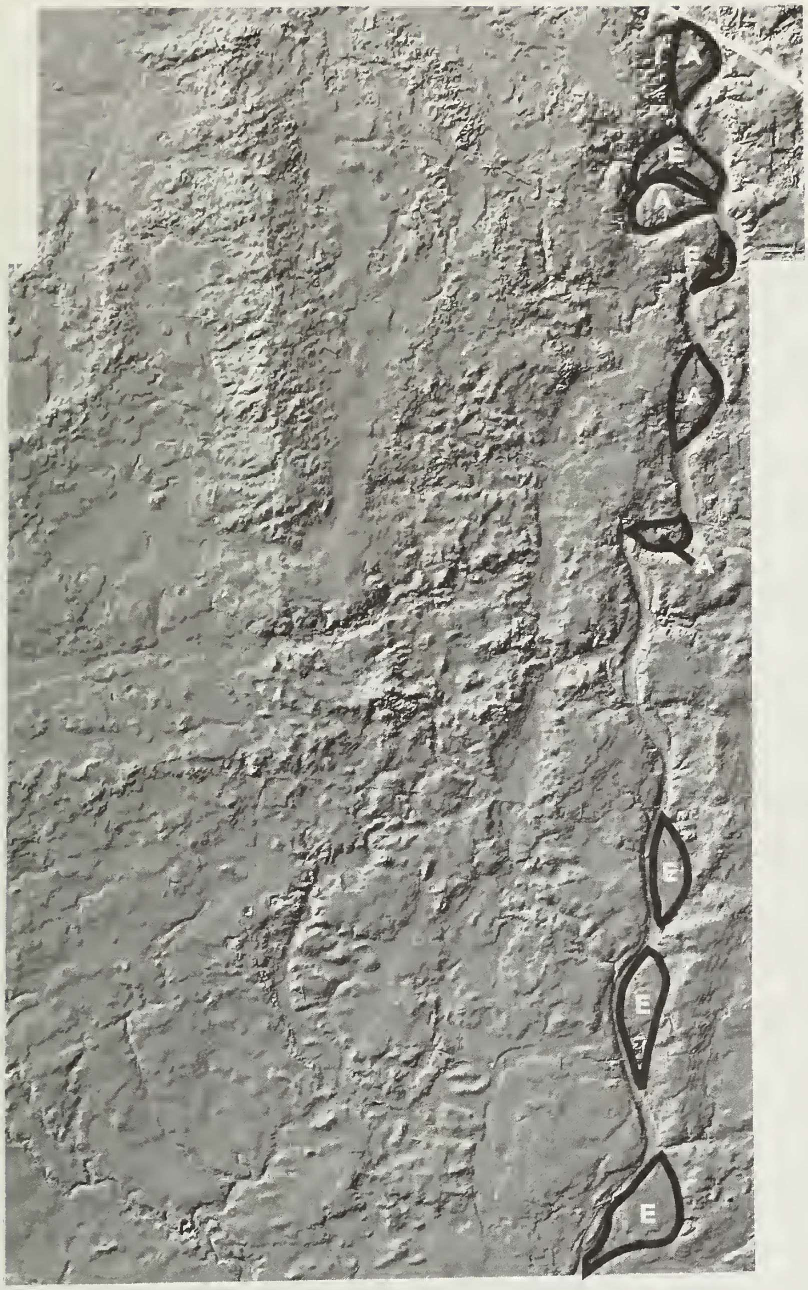


Figure 11 Maximum extent of glacial ice in northeasternmost Kane County during the Woodstock Phase (≈16,000 to 15,500 yr B.P.) and terraces formed primarily by aggradation (A) or erosion (E) along the Fox River valley. Hachured line (upper right) indicates ice margin.

The ***postglacial grass phase*** (≈3,000 to 170 yr B.P.) occurred while peat rapidly filled in the lake. Macrofossils indicate that the grass (Poaceae) pollen is largely from aquatic grasses, such as wild rice (*Zizania aquatica*) and common reed (*Phragmites communis;* fig. 12, zone 6). Interpretation of regional climate is problematic for this phase because the pollen is locally derived and overwhelmed the pollen rain from elsewhere in the basin and beyond. Other studies conclude that during this time the midwest climate returned to moist conditions, but not as moist as the earlier deciduous phase (Baker et al. 1992, 1996).

The ***postglacial settlement phase*** (170 yr B.P. to the present) is marked by a rise of ragweed (*Ambrosia*-type) pollen, which indicates settlement by Europeans in the mid-19th century (fig. 12, zone 7).

The postglacial ostracode assemblage (9,000 yr B.P. to the present) includes *Candona ohioensis, Candona acuta, Cypridopsis vidua,* and uncommon *Potamocypris unicaudata* (fig. 13). Except for *P. unicaudata*, this assemblage is typical of small lakes in wetland complexes throughout northern Illinois (Curry 1995). The relative abundance and ecology of these species suggests that there were no profound changes in the paleohydrology of Nelson Lake during postglacial phases.

METHODS

Particle size distribution was determined by hydrometer. The percentage of gravel (>2-mm) was calculated from samples weighing from 15 to 40 grams. The weight of the gravel fraction was subtracted when calculating the relative percentages of sand, silt, and clay in the <2-mm fraction of subsamples. The categories of particle size of the <2-mm fraction included sand (2 mm to 0.063 mm), silt (0.063 to 0.004 mm), and clay (<0.004 mm; table 2). Semi-quantitative phase analyses, commonly referred to as clay mineral analyses, were done using oriented, aggregated, glycolated slides of the <2-µm fraction (Wickham and others 1988). Magnetic susceptibility (MS; volume susceptibiliity) was measured in SI units with a Bartington magnetic susceptibility meter (MS2) and probe (MSF). The sensor emits a 1-Oersted alternating magnetic field, and the operating frequency of the probe is 580 Hz. Ten MS values were averaged at each depth analyzed.

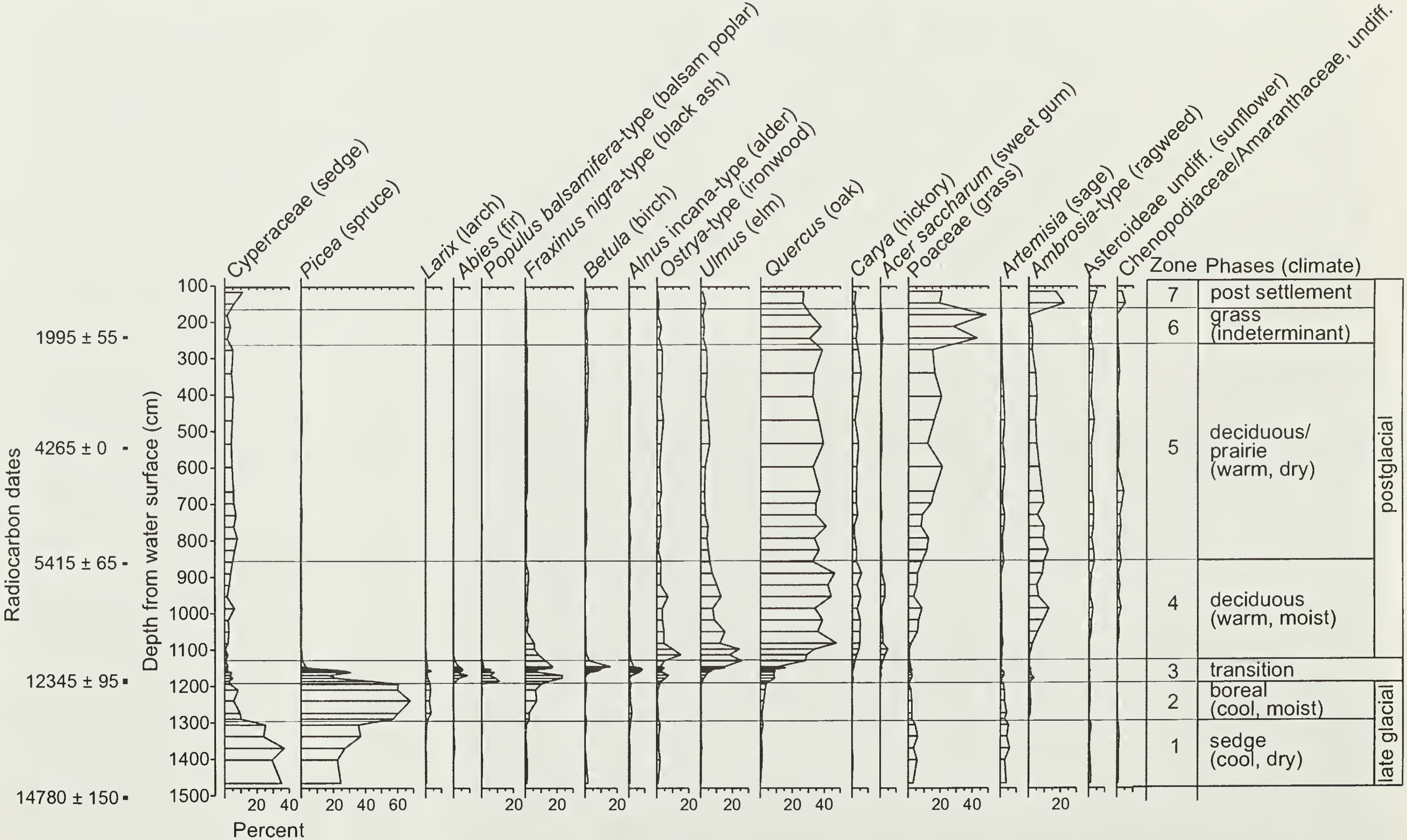


Figure 12 Summary pollen diagram of core from Nelson Lake. Analyst: E.C. Grimm.

Table 1 Radiocarbon ages

	Corrected C-14 age	ISGS lab number	$\delta^{13}C$ (‰)	Material analyzed and stratigraphic unit
Stop 1: Fox River Stone quarry				
	29,500 ± 1,000	1872	–25.1	Wood in Tiskilwa Fm diamicton*
	39,400 ± 1,800	1426	–22.8	Wood in Batestown Mbr diamicton*
	35,300 ± 1,400	1275	–25.0	Wood in Yorkville Mbr diamicton*
	31,050 ± 810	3185	–25.8	Wood in Henry Fm*
	17,539 ± 128	A-0021	–25.5	Plant macrofossils in Equality Fm overlying Yorkville Mbr diamicton
Stop 2: Nelson Lake core				
	1,995 ± 55	AA-4675	**	Graminoid stem, 242 cm depth; 8 cm interval
	4,265 ± 60	AA-4676	**	Poaceae inflorescence, 546 cm depth, 8 cm interval
	5,415 ± 65	AA-4677	**	Graminoid fragments, 862 cm depth, 8 cm interval
	12,345 ± 95	AA-4678	**	*Picea* needles and seeds, 1186 cm depth, 16 cm interval
	14,780 ± 150	AA-4680	**	Wood fragments; 1505.5 cm depth, 11 cm interval
Stop 3: Feltes sand and gravel pit				
	24,000 ± 390	2108	–25.2	Redeposited rooted stump in Robein Mbr (inclusion in Tiskilwa diamicton)
	24,360 ± 430	1830	–25.7	*In situ* rooted stump in Robein Mbr
	24,670 ± 220	3982	–25.1	*In situ* rooted stump in Robein Mbr
	25,820 ± 310	4055	–26.4	*In situ* rooted stump in Robein Mbr
	28,180 ± 1,000	1799	–24.9	Wood in Equality Fm*

* Reworked from Robein Member, Roxana Silt

** The $\delta^{13}C$ value not measured

ROAD LOG

Mile

0.0 Leave the parking lot of the Super 8 Motel, Hunt Club Road, St.Charles, and TURN RIGHT (west) on Route 64 (Main Street) towards downtown St. Charles. We are descending the distal slope of the north–south-trending Minooka Moraine into the Fox River Valley. This moraine contains silty clay and clay diamicton of the Yorkville Member.

0.8 Downtown St. Charles is built on a sand and gravel terrace (Woodstock Phase outwash).

0.9 Cross the Fox River. Paleozoic dolostones occur below thin alluvium of the Cahokia Formation; rock is often exposed in foundation excavations along the east side of the river. Postglacial alluvium, generally less than 15 feet thick, consists of organic, fossiliferous silty loam and loam with sand and gravel lenses. Thicker and sandier deposits up to 20 feet thick occur along the Fox River. Postglacial alluvium contains weakly developed surficial and buried soils; these horizons have been, and continue to be, intensively burrowed by worms, crayfish, and other animals.

1.0 TURN RIGHT on Route 31. Until we reach the first stop, we are paralleling the Fox River and traveling upstream. We are now in the river's floodplain. Along this route, you will notice some fine examples of early prairie architecture.

1.8 Rise onto a terrace of the Fox River.

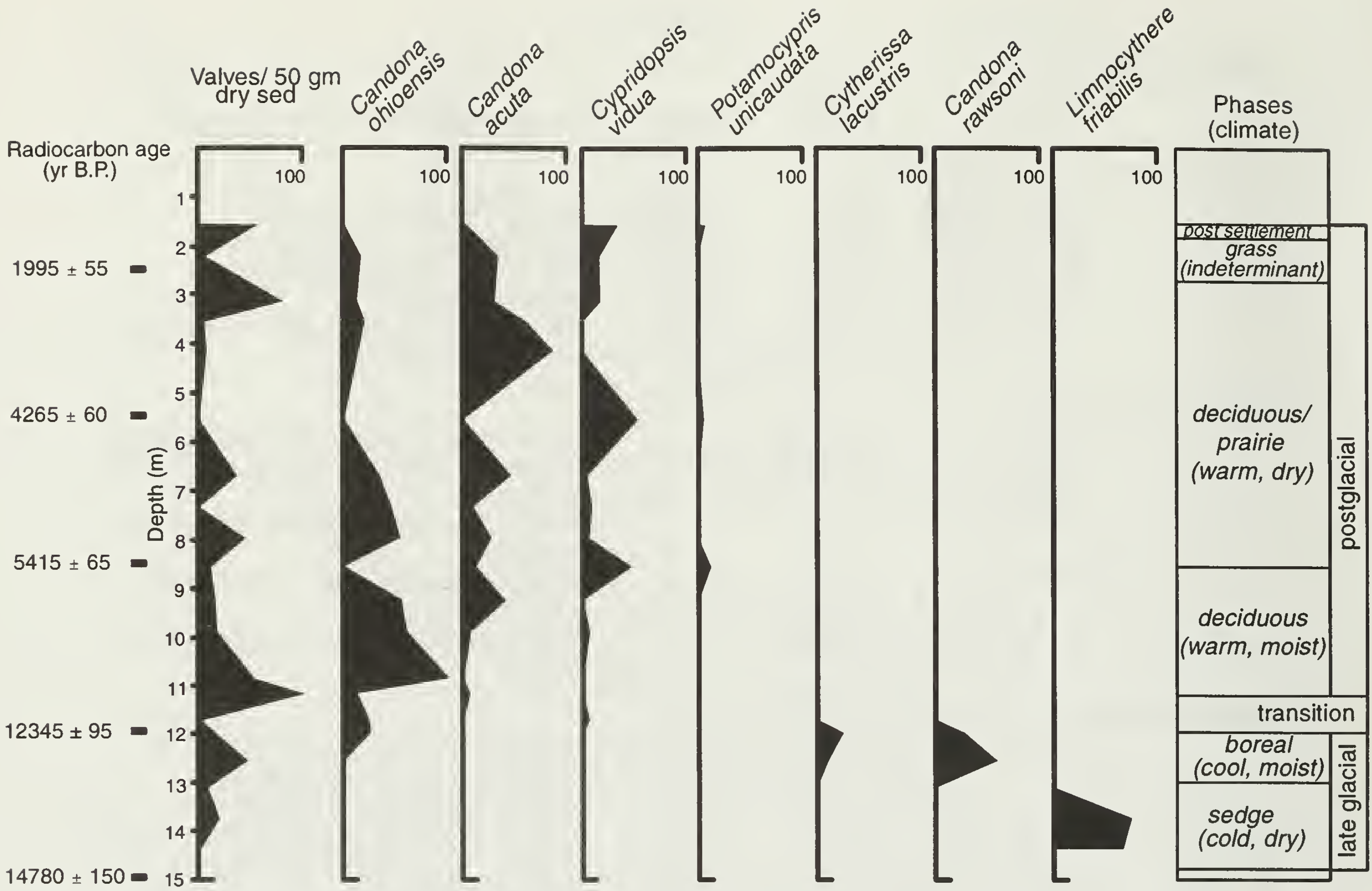


Figure 13 Relative ostracode diagram of core from Nelson Lake. Analyst: B.B. Curry.

2.2 Cross Ferson Creek, which cuts through the terrace.

2.5 Note entrance to Ferson Creek Fen Nature Preserve on the right. This area occurs on a floodplain that has a spring and peat fen. Groundwater travels through terrace sands and gravels and above impermeable till deposits and then upwells in this nature preserve. We rise back onto the terrace after passing this entrance.

3.7 Rise onto the St. Charles Moraine. Like the Minooka Moraine, this moraine contains fine-grained diamicton of the Yorkville Member.

5.1 Follow bend in Route 31 to the east, which parallels a tight bend in the Fox River.

5.8 TURN LEFT onto McLean Boulevard.

5.9 TURN LEFT into Fox River Stone quarry parking lot. After checking in, we will drive another 0.75 miles west into the bottom of the quarry.

Table 2 Particle size distribution, clay mineral data, blow count, and moisture content data for several lithostratigraphic units

		<2 mm (%)			Relative percentage			Counts/sec				
	Total gravel	Sand	Silt	Clay	Expandable clay minerals	Illite	Kaolinite plus chlorite	Calcite	Dolomite	Diffraction intensity index	Blow counts	Moisture content (%)
Peoria Silt												
Mean	0.9	8.5	62.9	28.6	78.0	16.4	5.6	2	8	1.9	12	21.7
Standard Deviation	1.3	6.8	7.6	5.9	11.7	10.4	1.8	15	28	0.7	8	4.8
Maximum	4	26	81.2	36	92	47	9	20	47	3.9	32	28.1
Minimum	0	1	48	17.5	45	5	3	0	0	1.1	3	12.5
Number of samples	12	12	12	12	14	14	14	14	14	14	15	11
Yorkville Member, Lemont Formation												
Minooka Moraine												
Mean	5.2	10.5	47.0	42.5	4	77	19	26	50	2.6	32	17.2
Standard Deviation	5.9	6.3	9.3	8.1	3.5	1.8	1.9	9.5	13.2	0.3	20	2.6
Number of samples	341	380	380	380	94	94	94	94	94	94	267	381
St. Charles Moraine												
Mean	4.0	8.6	36.3	55.1	3	79	18	22	44	2.9	38	20.1
Standard Deviation	5.6	6.4	6.7	8.9	1.2	2.2	2.4	10.5	15.2	0.4	18	3.3
Number of samples	210	227	227	227	34	34	34	34	34	34	245	245
Batestown Member, Lemont Formation												
silt loam diamicton facies												
Mean	16.6	32.5	42.5	25.0	8.7	76.6	14.7	19	36	4.1	20	14.7
Standard Deviation	14.6	8.2	5.7	7.4	2.8	5.9	4.8	13	17	1.9	9	2.1
Maximum	51.9	46.9	52.4	34.8	14.0	86.5	21.0	54	62	8.1	36	19.1
Minimum	5.4	19.2	28.3	10.9	4.0	67.5	7.0	0	0	2.1	7	12.6
Number of samples	11	11	11	11	12	12	12	11	12	12	13	6
loam diamicton facies												
Mean	10.2	39.3	40.9	19.8	17.2	67.9	14.9	21	58	3.6	19	13.3
Standard Deviation	9.7	11.2	9.7	6.0	15.3	14.4	5.0	13	38	1.8	12	2.6
Maximum	49.0	70.4	65.4	29.0	76.0	88.0	24.0	41	180	9.4	50	21.5
Minimum	0.0	15.6	25.6	4.0	1.5	15.0	6.0	0	0	1.1	4	10.0
Number of samples	23	23	23	23	22	22	22	19	22	22	23	18
Tiskilwa Formation diamicton												
Mean	7.0	33.8	39.1	26.7	13.0	64.6	22.0	47	69	2.1	65	10.8
Standard Deviation	5.2	5.0	4.7	4.9	3.8	3.4	2.9	25	20	0.5	78	1.3
Maximum	46.0	51.8	65.6	41.0	28.0	78.0	31.0	335	155	5.1	600	15.1
Minimum	0.0	5.4	26.0	7.7	3.0	56.0	13.0	10	17	1.1	8	7.7
Number of samples	202	202	202	202	202	202	202	202	202	202	202	202
Glasford Formation diamicton												
Mean	11.1	39.9	36.4	23.7	14.2	67.3	18.5	42	79	3.1	110	10.2
Standard Deviation	10.9	12.5	6.7	9.4	10.3	11.7	4.8	16	23	3.3	173	2.9
Maximum	57.3	62.0	50.0	48.0	73.0	92.0	26.0	80	160	26.0	1200	18.2
Minimum	0.0	2.0	16.0	11.0	1.5	18.0	6.0	10	32	1.4	22	4.4
Number of samples	63	65	65	65	68	68	68	68	69	69	58	55

STOP 1: FOX RIVER STONE QUARRY—*David Grimley, Brandon Curry, Ardith Hansel, and Richard Baker*

The Fox River Stone quarry has been a source of limestone and crushed limestone since 1948. Today, about 40 feet of Silurian dolostone is mined and crushed for aggregate marketed primarily in Kane, Du Page, and western Cook Counties. A minor portion is used for agricultural lime.

The 80-foot-high walls of the Fox River Stone quarry, cut into the crest of the St. Charles Moraine, reveal the most complete sediment record of the Lake Michigan Lobe north of Wedron Quarry (Johnson and Hansel 1990), which confirms regional correlation of stratigraphic units and glacial events (Hansel and Johnson 1992, 1996, Curry et al. 1997). Four lithologically distinctive diamictons of the last glaciation comprise the bulk of the sediment record. The diamicton units are differentiated by color, particle size distribution, clay mineralogy, magnetic susceptibility, and moisture content. The general uniformity of each diamicton and the strong pebble fabrics measured within them are consistent with a subglacial origin. Abundant sorted sediment in the middle loam diamicton unit (the Batestown Member), including Rothlisberger (R) channels (Drewry 1986), suggests deposition as melt-out till in an ice-marginal environment. Patchy deposits of sorted sediment that occur between the diamicton units are interpreted as proglacial outwash deposited during retreat and readvance of the ice. A surficial, near-glacial deltaic/outwash sequence associated with formation of the Minooka Moraine 1 mile east of the quarry contains a fossiliferous lacustrine facies with tundra plants, cryophyllic ostracodes, and fingernail (pisidiid) clams (Curry et al. 1999).

In northeastern Illinois, two sets of near-orthogonal joints occur in bedrock. The average direction of one set is N47°E, and the other set, N50°W (Foote 1982). Joints observed at the Fox River Stone quarry follow this trend, with the most prominent joints striking about N32°E, and secondary joints striking N55°W. Striations on the Silurian bedrock surface are observed in a few areas in the quarry. The mean trend of 21 striations measured near Section B (fig. 14) is 83°; the striations range from 78° to 86° and were likely formed by glacial abrasion during the Illinois Episode.

Lithostratigraphic Units

Glasford Formation, undifferentiated The oldest Quaternary deposit at the quarry is olive yellow (5Y 6/6), sandy loam diamicton with abundant dolostone clasts. The diamicton is generally no more than 5 feet thick, and is observed most often in the southern part of the quarry (fig. 14). Although the unit resembles dolomite residuum, it contains uncommon erratics composed of granite or other crystalline rocks, and the diamicton matrix contains appreciable quartz sand. Because the diamicton is covered by organic silts, described below, it is correlated with the Glasford Formation of the Illinois Episode (fig. 5b).

Robein Member, Roxana Silt A distinct unit composed of black to very dark brown (10YR 2/1), leached silt loam and wood fragments often occurs above bedrock or as inclusions in the overlying units. Less than 3 feet thick at the quarry, this layer has been traced throughout northeastern Illinois, where it may also be compact peat, soupy muck, or stratified organic-rich silt as much as 28 feet thick (Kempton et al. 1987). Interpreted to be pedogenically altered colluviated loess, this unit ranges in age from about 55,000 to about 23,500 yr B.P. in Kane County (table 1; Wickham et al. 1988, Curry 1989, Hansel and Johnson 1996) and is correlated with the Robein Member of the Roxana Silt. We will observe a more complete section of the Robein Member and the last interglacial paleosol, the Sangamon Geosol, at Stop 3.

Tiskilwa Formation Overlying the bedrock, the basal olive-yellow diamicton, and the black buried soil is the oldest diamicton unit of the last glaciation. As much as 40 feet thick in the southwestern quarry highwall, the unit is composed of brown (7.5YR 4/2) loam to clay loam diamicton and contains channel-shaped bodies of sand and gravel or sand (figs. 14 and 15). Locally, a stratified facies

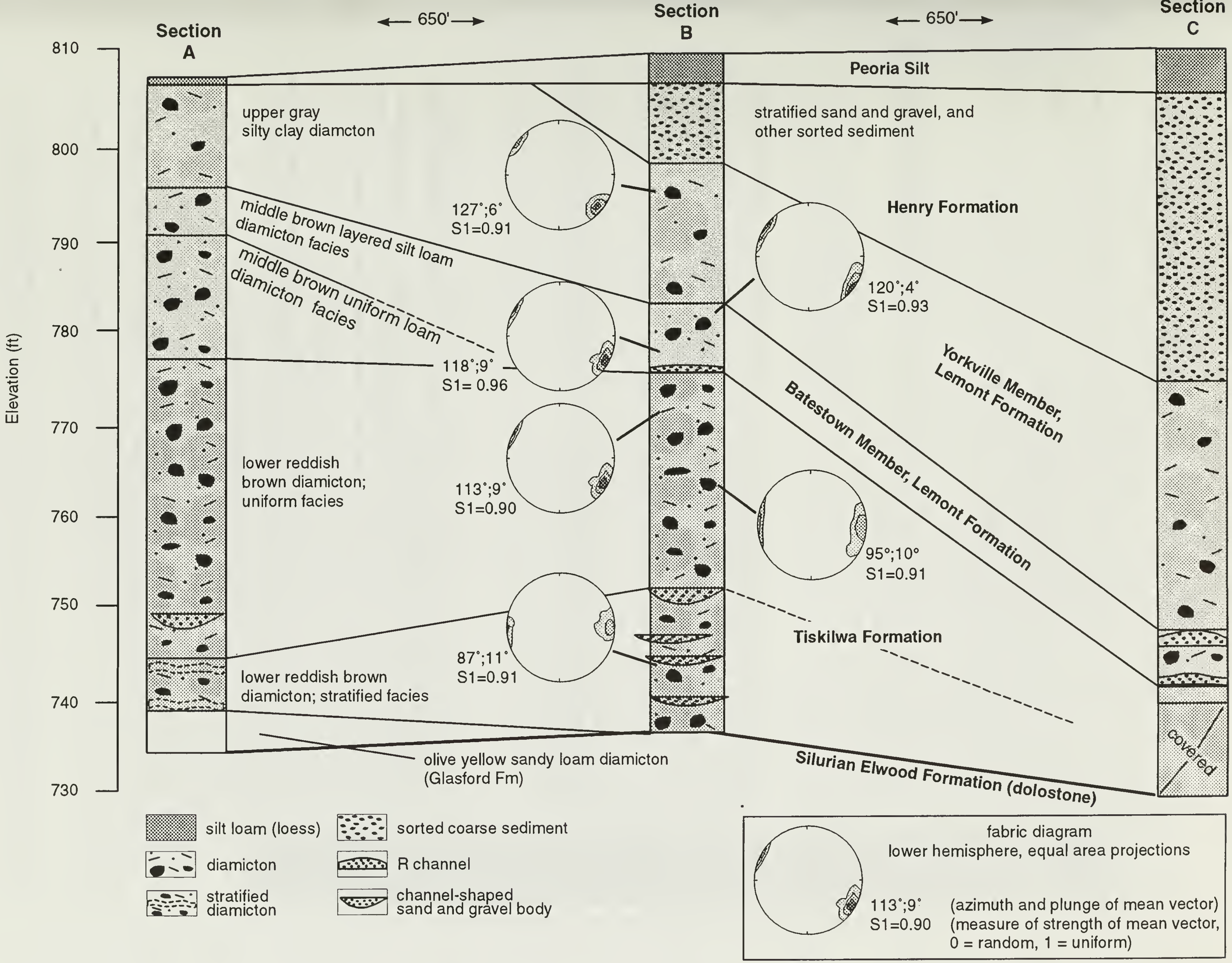
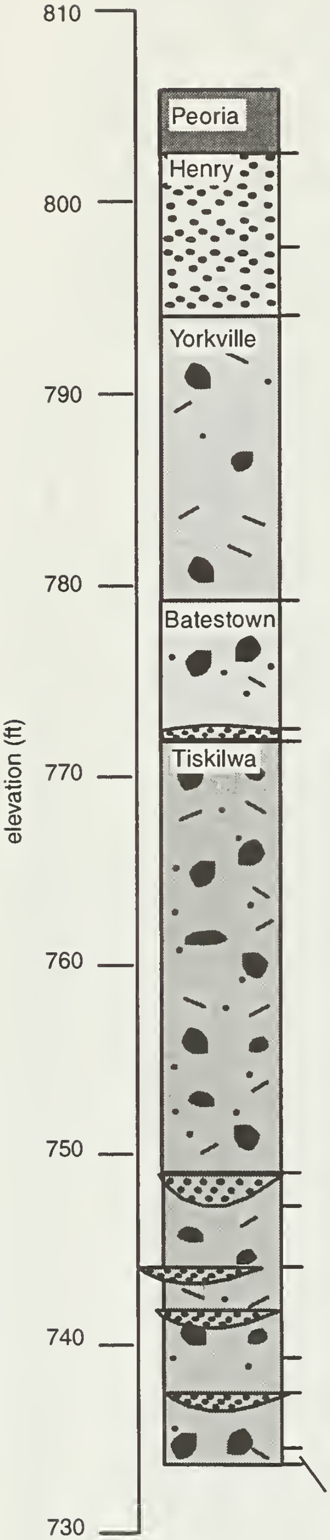


Figure 14 Lithofacies log, prolate pebble fabrics, and correlation of lithostratigraphic units at the Fox River Stone quarry (Stop 1).



0.0 - 3.2 ft Modern soil developed in silt loam to silty clay loam; yellowish brown (10YR 5/4) in lower half, upper foot is dark brown Ap horizon (LOESS)

3.2 - 9.3 ft Coarse sand with about 25% rounded, cobbly gravel; cobbles are composed of about 65% dolostone, 30% shale, and 5% metamorphic and igneous rocks (OUTWASH)

9.3 - 11.6 ft Dark grey (2.5Y 4/1) sand and gravel, moderately well-sorted, stratified, gravelly sand with cobble lag. About 60% of the clasts are shale (OUTWASH)

11.6 - 27.5 ft Grey (5Y 5/1) clay to silty clay diamicton; very firm. The lower contact is abrupt with some local soft sediment deformation in basal layers less than one foot thick. The matrix is uniform to vaguely stratified with whispy silt laminae, especially in the upper 10 ft (SUBGLACIAL TILL)

27.5 - 33.5 ft Brown (10YR 5/2.5) pebbly silt loam diamicton with thin, subhorizontal layers of very fine-grained sand, and few R channels (SUBGLACIAL MELT-OUT TILL)

33.5 - 34.5 ft Clast-supported sandy loam diamicton with large cobbles, crudely imbricated (SUBGLACIAL or ICE-MARGINAL FLUVIAL SEDIMENT)

34.5 - 58.0 ft Brown (7.5YR 4/2) pebbly loam to clay loam diamicton, uniform. Elsewhere in the outcrop, channel-shaped bodies were observed at a depth of 18.2 to 19.6 ft, and 27.7 to 29.7 ft containing vaguely stratified, well-sorted, medium sand with thin layers and irregular blobs of diamicton up to 4 inches across (SUBGLACIAL TILL)

58.0 - 61.3 ft Moderately well-sorted gravelly medium and coarse sand with thin layers of diamicton, stratified and deformed (SUBGLACIAL CHANNEL-FILL DEPOSIT)

61.3 - 63.0 ft Pebbly loam diamicton as above, but with abundant wood fragments; one large wood fragment yielded an age of 29,500 ± 1,000 yr B.P. (ISGS 1872) (SUBGLACIAL TILL)

63.0 - 66.5 ft Channel-shaped bodies containing clast-supported, crudely stratified sandy gravel (SUBGLACIAL CHANNEL-FILL DEPOSIT)

66.5 - 69.5 ft Pebbly loam diamicton as above with crude horizontal partings about 1 inch apart. The lower 6 inches is very hard and has an abrupt contact (SUBGLACIAL TILL)

69.5 - 72.3 ft Brown (7.5YR 4/2) loam diamicton containing abundant, angular fine gravel along vaguely defined bedding planes. One very crudely stratified bed is 1.5 to 2.0 inches thick with bedding folded to near vertical, truncated, and overlain by uniform diamicton (SUBGLACIAL TILL)

72.3 - 73.8 ft Brown (7.5YR 4/2) pebbly loam diamicton (SUBGLACIAL TILL)

73.8 ft + Silurian dolostone

Figure 15 Description of sediment succession at Section B, Fox River Stone quarry.

occurs that is composed of mostly subhorizontal beds of sorted sediment interbedded with layers of very hard diamicton. In the stratified facies, scattered deformed and truncated channel-shaped bodies, in addition to sheared and slickensided inclusions of organic silt, attest to deposition in an active ice environment, especially in the lower 20 feet. Prolate pebbles have strong preferred orientations at Section B; three pebble fabrics yielded S1 values of 0.90, 0.91 and 0.91 (fig. 14). Both the uniform diamicton and stratified facies are interpreted to be subglacial till deposited beneath active ice. The sand percentage of the <2-mm fraction is between 30% and 37 %, and the <0.004-mm clay fraction is between 26% and 34% (fig. 16). The <2-µm fraction contains about 65% illite relative to other clay minerals. The texture and clay mineral values are consistent with correlation of the lower reddish brown clay loam diamicton unit with the Tiskilwa Formation in northeastern Illinois (table 2; Wickham et al. 1988, Curry et al., in prep.). The mean bulk magnetic susceptibility (MS) of three depth intervals is $38 \pm 2 \times 10^{-5}$ SI units (fig. 16), which is typical for Lake Michigan Lobe-sourced tills (Grimley 1996).

Tiskilwa Formation sediment forms the prominent Marengo Moraine and Bloomington Morainic System and is as thick as 270 feet in Kane County (fig. 5a). The character and depositional history of this unit are described in detail by Wickham et al. (1988). We will see a sandy facies of Tiskilwa Formation diamicton at Stops 3 and 5.

Batestown Member, Lemont Formation Overlying the lower reddish brown Tiskilwa till is a uniform loam diamicton overlain by layered silt loam diamicton containing interbeds of sorted sediment. The uniform loam diamicton facies is brown (7.5YR 5/2) and as much as 14 feet thick. The <2-mm matrix of the uniform loam facies contains from 35% to 50% sand, but the layered silt loam facies contains about 20% to 30% sand (table 2). The <2-µm fraction of the uniform loam facies and layered silt loam facies contain about 70% illite. Prolate pebbles at Section B (fig. 14) have strong preferred orientation, with S1 values of 0.93 and 0.96. The uniform diamicton is interpreted to be subglacial till deposited beneath active ice. It is overlain by the layered silt loam diamicton facies, which is yellowish brown (10YR 5/2) and from 3 to 5 feet thick (fig. 14). Thin, discontinuous layers of very fine sand and silt and less common layers of green material, described below, impart stratification in the layered facies. The texture and stratigraphic position indicate that the two diamicton facies correlate with the Batestown Member of the Lemont Formation (Curry et al., in prep.).

The layered facies of the Batestown Member contains thin (≈<4 inches thick), discontinuous layers of light greenish gray (5GY 7/1) loam diamicton containing disintegrated fragments of mafic rocks and anorthosite. The mafic-rich zones have also been observed elsewhere in Kane County and at Wedron Quarry (Hansel and Johnson, in press). The provenance of some of the clasts can be traced to a few outcrops in the Sudbury region of southern Canada (François Hardy, ISGS, personal communication). The abundant mafic clast content probably is at least partly responsible for the high MS values of $51 \pm 2 \times 10^{-5}$ SI (fig. 16), the highest value measured at the quarry.

Both facies of the Batestown Member at the Fox River Stone quarry are associated with abundant lenses, layers, and channel-shaped bodies of clay-poor sediment. This material ranges in texture from very poorly sorted, clast-supported sandy loam diamicton to well-sorted, cross-bedded fine to coarse sand. In the layered facies, channel-shaped deposits with coarser sediment are often small (largest general dimensions of 2 to 3 feet thick, 5 to 10 feet wide). Some drape over large clasts. Tabular beds of cross-bedded finer-grained sands may be continuous over across as much as 50 feet. In 1987, a body of well-sorted, uniform medium sand was observed in an anomalously thick section of layered silt loam diamicton that was about 500 feet long and 30 feet thick. It had a flat base and gently arched upper surface. This sand body is interpreted to represent a large R channel (Drewry 1986). Other smaller R-channel deposits have been observed in the layered Batestown diamicton (fig. 15), which we interpret to be a melt-out till.

The Batestown Member is as thick as 50 feet in Kane County and is the surficial diamicton in much of central Kane County (fig. 5a; Curry et al., in prep.). Batestown diamicton is associated with sand

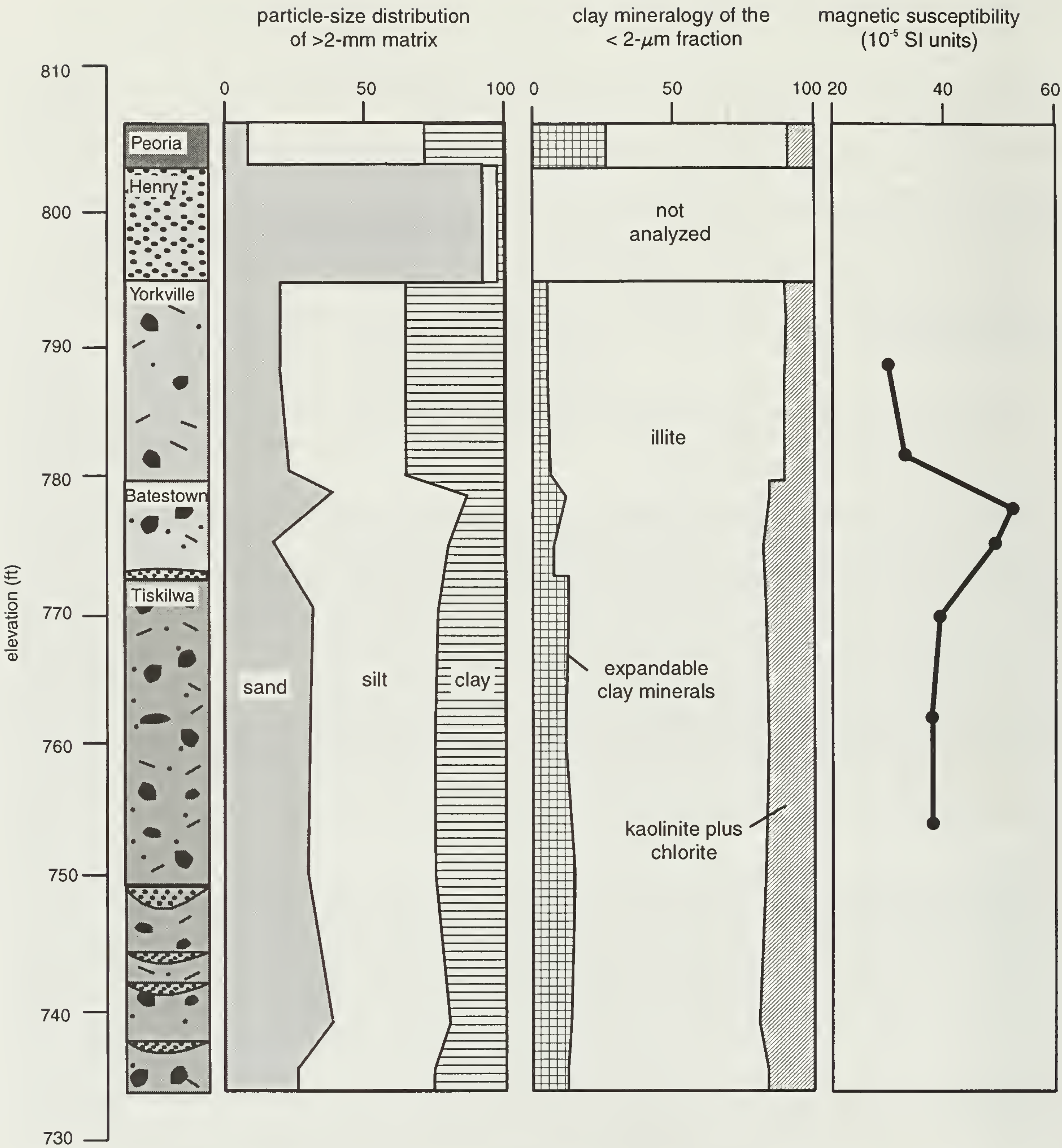


Figure 16 Particle size distribution and magnetic susceptibility of lithostratigraphic units at the Fox River Stone quarry, Section B (Stop 1).

and gravel as thick as 100 feet in kamic areas throughout Kane County (Grimley et al., in review a, b). Later on the field trip, we will drive by several large landforms formed by Batestown-associated sand and gravel, such as Johnson's Mound, mined-out Bald Mound, and the Campton Hills. We have correlated the sand and gravel with the Wasco (ice-contact) facies of the Henry Formation (Grimley et al., in review a, b).

Yorkville Member, Lemont Formation The unweathered diamicton is gray (5Y 5/1) silty clay to clay diamicton that oxidizes yellow brown (10YR and 2.5Y Munsell values) in the upper 10 to 15 feet. The thickness of the upper gray diamicton ranges from about 12 feet to more than 30 feet. The upper grey diamicton contains fewer pebble to boulder clasts than do the other diamictons. Prolate pebbles at Section C have strong preferred orientation, with S1 values of 0.91 (fig. 14). The <2-mm matrix contains less than 10% sand and about 40% to 60% clay. At one site, magnetic susceptibility values averaged $32 \pm 2 \times 10^{-5}$ SI, the lowest values measured at the quarry. The <2-µm fraction contains from about 75% to 80% illite (fig. 16). The upper gray diamicton is very stiff to hard and tends to be smeared and distorted by earth-moving equipment. Channel-shaped bodies of sand and gravel occur, but they are less common than in the other diamictons. We correlate the upper gray diamicton, which we interpret to be till, with the Yorkville Member of the Lemont Formation; its color, texture, and clay mineralogy are particularly distinctive.

Henry Formation and tongue of the Equality Formation At the northwest corner of the Fox River Stone quarry is as much as 30 feet of surficial sorted sediment (fig. 14). Notable features include an abundance of gravel-sized shale clasts, and a tongue of fossiliferous sorted sediment. From bottom to top, the succession consists of a lag of coarse-grained sand and pebbles; planar-bedded sand and gravel; cross-bedded, well-sorted medium sand; very fine-grained sand and rhythmically bedded mud; and a capping layer of planar-bedded sand and gravel. Imbricated clasts indicate westward paleoflow. Interpreted to be outwash, the surficial sands are mapped as the Henry Formation, whereas the fossiliferous muds are lacustrine and deltaic sediment classified as a tongue of the Equality Formation.

In November 1998, about 20 feet of rhythmically bedded silty clay and silt to very fine sand was exposed in the northwest corner. The beds yielded plant macrofossils, ostracodes, and clam shells (table 3) . The ^{14}C age of several wood fragments and seeds is 17,539 ± 128 yr B.P. (ISGS-A-0021). These sediments are part of a larger deposit of sorted sediment that occurs atop the St. Charles Moraine north of the quarry (fig. 10). The abundance of shale clasts indicates that the sorted sediment is related to the upper gray Yorkville diamicton. We interpret the succession of coarse-grained/fine-grained/coarse-grained sediment to reflect deposition of a fan-delta that formed on an ancient lowland surface of Yorkville diamicton. The lower coarse-grained sediment and lacustrine mud reflects deposition during retreat of ice from the St. Charles Moraine, and the capping coarse-grained sediment refects deposition during the later advance to the Minooka Moraine east of the quarry. The broken leaves and other plant fragments, which likely came from vegetation that grew on the early outwash deposits, were later redeposited in the lake. The undisturbed bedding in the sand and gravel deposits below the lake sediment indicates that the lake formed by damming of a channel and not by melting of ice blocks.

With the exception of the *Brassicaceae* (mustard) seed, the vegetation listed in table 3 grows today in the sandy and peaty soils in the tundra of northern Canada (Hultén 1968; Hultén and Fries, 1986). The assemblage has also been found in several other full-glacial sites in the central Midwest (Baker et al. 1986, Birks 1976, Garry et al. 1990; Maher et al. 1998). The ostracode assemblage, with the exception of the new species of *Cypria*, has been found elsewhere in near-glacial lacustrine sediment (e.g., Maher et al. 1998). The ostracode assemblage indicates that the water had been evaporatively concentrated or contained significant groundwater.

Table 3 Plant macrofossils, ostracodes, and pisidiid clams identified from a tongue of the Equality Formation at the Fox River Stone quarry

Plant macrofossils

- leaves of *Dryas integrifolia* (entireleaf mountainavens)
- calyces of *Armeria martima* (thrift seapink)
- leaf fragments of cf. *Vaccinium uliginosum* (alpine bilberry or bog blueberry)
- leaf fragments of *Salix* (cf. *S. herbacea*) (snowbed willow)
- seeds of *Brassicaceae* (mustard)

Ostracodes

- *Limnocythere friabilis* (abundant; females only)
- *Limnocythere herricki* (rare; females only)
- *Heterocypris* cf. *incongruens* (common)
- *Cytherissa lacustris* (rare juveniles only)
- *Cypria* n.sp. (uncommon)

Pisidiid clams

- *Pisidium ferrugineum, P. conventus* (common)

5.9 After leaving the quarry, TURN RIGHT onto McLean Boulevard.

6.0 TURN RIGHT on Route 31.

6.7 TURN RIGHT on Silver Glen Road. We are now traveling west and ascending the proximal slope of the St. Charles Moraine.

7.5 Crest of the St. Charles Moraine.

8.3 After descending the distal slope of the moraine, we begin to drive on a terrace along Otter Creek. Sand and gravel underlying this terrace has been observed in foundation excavations. This sand and gravel is probably a down-current facies of the fan-delta we visited at the Fox River Stone quarry.

8.5 Cross Otter Creek. With rapid urban development occurring in Kane County, streams tributary to the Fox River (such as Otter Creek) are rapidly eroding the Quaternary deposits.

8.6 TURN LEFT on Burr Road and proceed south. To the right are uplands of the Elburn Complex composed of loam diamicton of the Batestown Member and very poorly sorted sand and gravel of the Wasco facies of the Henry Formation.

10.9 Entering area of kamic hills containing sand, gravel, and diamicton of the Wasco facies.

11.8 TURN LEFT on Dean Road.

12.1 TURN RIGHT on Peck Road. This lowland is another valley segment that was probably formed by ice-marginal meltwater erosion associated with the St. Charles Moraine during the early part of the Livingston Phase (fig. 8). The valley train is about 40 feet thick.

12.6 TURN RIGHT on Campton Hills Drive.

12.7 TURN LEFT on Peck Road.

15.5 TURN RIGHT on Kaneville Road, passing Peck Lake on the left.

16.1 TURN LEFT on Fabian Parkway.

16.4 TURN RIGHT on Wenmouth Road.

17.6 TURN RIGHT on Main Street.

18.1 TURN LEFT on Nelson Lake Road. Note the marsh to the right.

18.9 TURN RIGHT into the parking lot.

STOP 2: NELSON LAKE NATURE PRESERVE—*Mary Ochsenschlager, Brandon Curry, Eric Grimm, and David Grimley*

Nelson Lake is an Illinois State Nature Preserve and Kane County Forest Preserve that includes a 100-acre lake, 250 acres of marsh, and about 150 acres of adjoining land parcels (fig. 17). Early attempts to drain the marsh for agriculture were only partially successful, and a large portion of the marsh and shallow lake remain intact. The ponds at the north end of Nelson Lake were made during mining of low-quality peat for potting soil from about 1930 to 1970. After much effort on the part of the Nature Conservancy, the Illinois Department of Natural Resources, and a group of concerned citizens (the Nelson Lake Advocates), the marsh was purchased and dedicated as a preserve in 1985.

Nelson Lake is the largest, high-quality natural area in Kane County. It hosts such fen-loving plants as swamp thistle, grass of parnassus, Ohio goldenrod, marsh clubmoss, marsh wild timothy, and Kalm's lobelia. It is also home to several rare plants including wild rice, hoary willow, bog willow, dwarf birch, and cotton grass (Young 1994). Sandhill cranes nest at Nelson Lake, and bitterns, rails, and osprey are occasionally spotted or heard. One can also find the rare Baltimore checkerspot butterfly and several unusual skippers.

Nelson Lake is a kettle basin west of the St. Charles Moraine. A sediment core taken in 4.9 feet of water revealed the following sequence: coarse detritus and calcareous gyttja (4.9–12.5 ft); calcareous gyttja (12.5–34.1 ft); gyttja and silty gyttja (34.1–38.7 ft); gray silty clay (38.7–49.6 ft), and gravel (49.6–49.8 ft). The development of postglacial vegetation, paleohydrology, and climate was discussed above, and our interpretations are based on pollen and ostracodes identified in the core (figs. 12 and 13).

East and north of Nelson Lake is the St. Charles Moraine, which is formed of silty clay Yorkville diamicton and sorted sediment (Lemont Formation) (fig. 17; Curry, in prep.). South and west of Nelson Lake are broad, flat uplands that are underlain by thin diamicton overlying thick sand and gravel (Grimley, in prep. a, b). Correlation of the thin diamicton is problematic; it is sandier than typical Yorkville diamicton, but grayer and more illite-rich than Batestown diamicton. We interpret that the thin diamicton was a debris flow deposited on outwash associated with the St. Charles Moraine; hence, the thin diamicton is tentatively correlated with the Yorkville Member.

Nelson Lake may have formed as kettle lakes are generally thought to form: by the melting of a large ice block within sediment-rich debris. A cross section shows that the bottom of Nelson Lake is about 40 feet below the elevation of the lower contact of the Yorkville to the east and west (fig. 17). As an alternative hypothesis, we suggest that the Nelson Lake basin may have formed by a glacially influenced, pressurized groundwater blowout. Prior to the blowout, the thin layer of Yorkville diamicton described above was a confining layer and kept groundwater in the underlying sand and gravel in communication with englacial water. During formation of the moraine, the hydrostatic head increased to a threshold pressure, eventually causing fluidization ("blowout") of the sand and gravel, and failure of the thin diamicton lid. The cavity formed the basin occupied today by Nelson Lake.

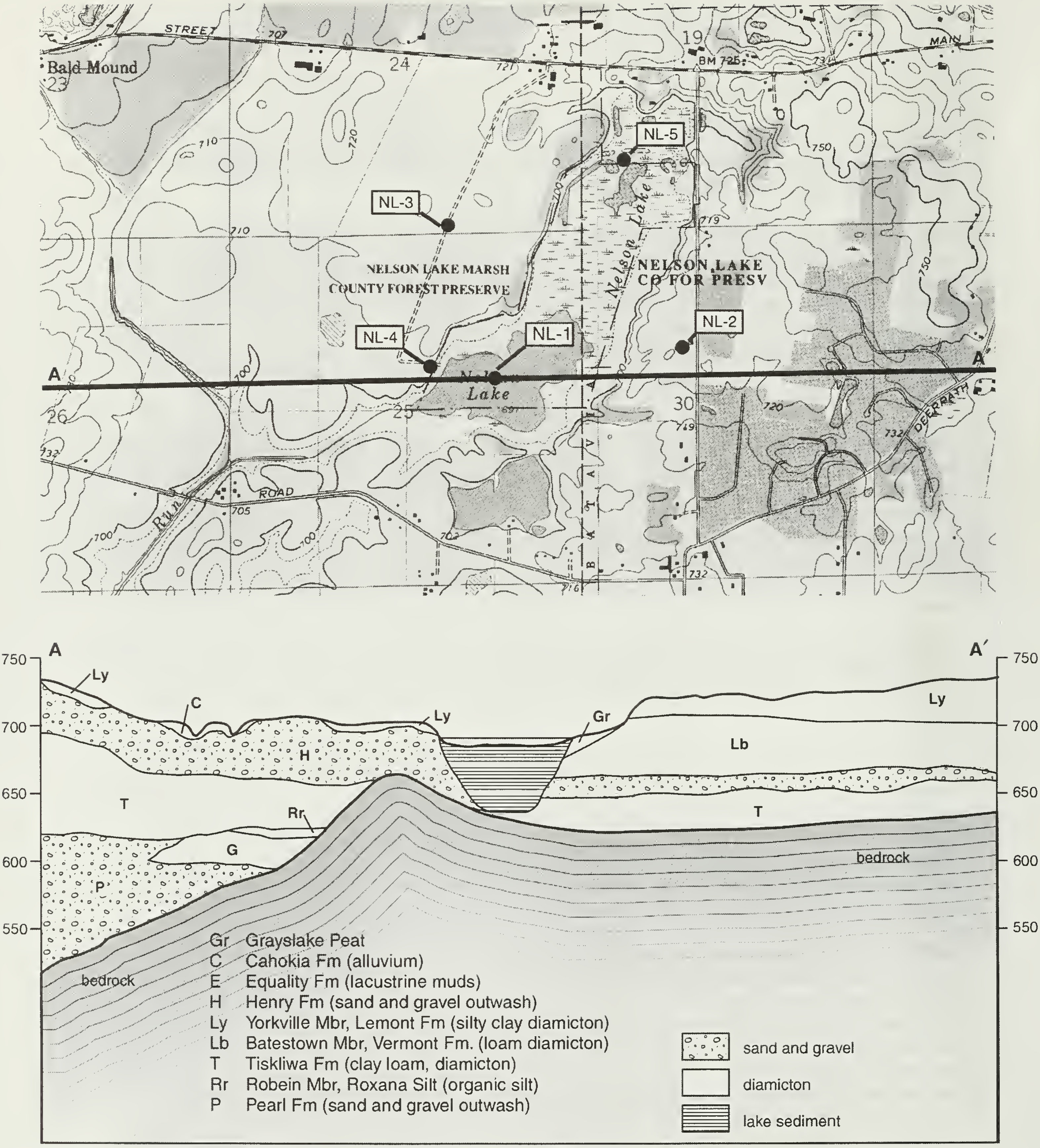


Figure 17 Portion of the Sugar Grove and Aurora North 7.5-minute maps showing the watershed of Nelson Lake, the line of cross section, and cross section A–A′.

18.9 TURN LEFT on Nelson Lake Road.

19.7 TURN LEFT on Main Street, proceeding west.

20.9 Cross creek underlain by outwash interpreted to be associated with the St. Charles Moraine. To the west, we will begin to drive across the Elburn Complex.

21.4 Take off your hats out of respect to Bald Knob on your right, a kame that was sacrificed for the foundations and roads of Kane County. Bald Knob was the largest kame in Kane County, but sand and gravel mining have inverted its original topographic expression. In 1919, M.M. Leighton estimated the intact kame to be 80 to 100 feet high, extending north for over 0.5 mile. Both W.E. Powers in 1929 (Leighton et al., 1928–1930) and D.L. Gross in 1968 (Gross 1969) described 6 to7 feet of yellow-brown to pale pink silty sandy till (that we correlate with the Batestown Member) underlain by more than 40 feet of sorted sand, silt, and gravel of the Wasco facies of the Henry Formation.

21.7 Cross buried thalweg of the St. Charles Bedrock Valley. There is no hint on the present-day landscape of this valley because it is filled with glacial debris.

22–23 To the right is Johnson's Mound, a kame owned by the Kane County Forest Preserve.

24.7 The lake on the right is a mined-out kame (Gross 1969).

24.9 TURN RIGHT on Route 47.

25.5 TURN LEFT into driveway for the Feltes sand and gravel pit.

25.9 Stop at weighing station.

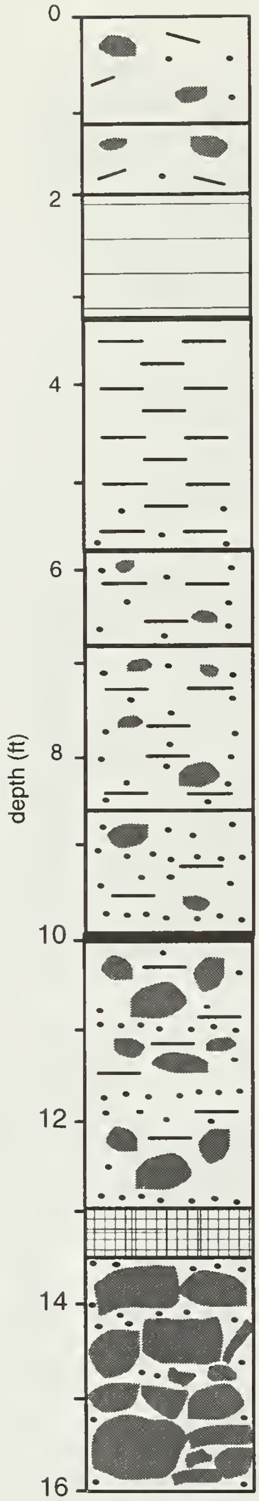
STOP 3: FELTES SAND AND GRAVEL PIT—*Brandon Curry, Jay Stravers, and David Grimley*

The Feltes sand and gravel aggregate pit is located about 2.5 miles south of the village of Elburn on a broad, flat upland west of the south-flowing Blackberry Creek. The primary aggregate mined at both pits is gravelly coarse sand of the next-to-last glaciation (Pearl Formation) and the surficial, fine sands of the last glaciation (Henry Formation; fig. 5b). Current production at the Feltes pit is from 850 to 900 tons an hour (about 1 million tons per year). The privately owned Feltes pit has been open since 1970, and there are at least 20 years of reserves on the property. The pit owners plan to keep the dredged lake open for recreation after the pit closes.

The north–south-trending Elgin Bedrock Valley, a major tributary of the St. Charles Bedrock Valley (fig. 3), occurs just to the east of the Feltes sand and gravel pit. A pump test of a test-well located about 100 feet east of the entrance to the Feltes aggregate pit indicated a potential yield of 1.5 million gallons per day for the basal sand and gravel deposits in the Elgin Bedrock Valley (Layne-Western 1972). This is the greatest potential yield yet estimated from tests of glacial drift aquifers in Kane County (Curry and Seaber 1990). The tested basal sand and gravel probably correlates with the Pearl Formation.

Stratigraphic Units

Pearl Formation The upper 50 to 65 feet of the Pearl Formation is dredged at both the Feltes and Prairie pits. The aggregate is composed of clast-supported, imbricated, bouldery coarse sand; well-sorted, cross-stratified coarse sand; and a capping, discontinuous layer about 5 feet thick of bouldery loam diamicton (figs. 18 and 19). The largest clasts are angular to rounded boulders; most



0.0 - 1.2 ft Brown (8YR 5/4) loam to silt loam diamicton; uniform; calcareous; gradational lower contact (3") (SUBGLACIAL TILL, Tiskilwa Formation)

1.2 - 1.7 ft Brown (7.5YR 4.5/2) loam to silt loam diamicton; uniform; calcareous; wavy, gradational lower contact (2") (SUBGLACIAL TILL, Tiskilwa Formation)

1.7 - 3.3 ft Brown (7.5YR 4.5/2) silty clay to silty clay loam; laminated. Silt bed, 0.01 ft thick, with small thrust features trending N59°E; calcareous; abrupt, wavy lower contact (2"); as much as 4.5 ft thick about 150 feet to the west (PROGLACIAL LACUSTRINE, Peddicord tongue, Equality Formation)

3.3 - 5.8 ft Very dark gray (10YR 3/1) to dark grayish brown (10YR 3.5/2) silt loam; wood fragments from 3.3 to 4.0 ft; platy structure and vague laminations imparted by organic matter; rare fingernail clam shells; weak klumpen; few root traces; weakly dolomitic; becomes sandier with depth, especially from 5.0 to 5.8 ft (Farmdale Geosol developed in COLLUVIATED LOESS, Robein Mbr., Roxana Silt). Spruce stumps, in growth position, yielded C-14 ages of 24,670 ± 220 yr B.P. (ISGS-3982) and 25,820 ± 310 yr B.P. (ISGS-4055)

5.8 - 6.8 ft Brown (10YR 4/21) sandy silt loam diamicton with thin, vertical to subvertical pockets filled with medium to fine sand; leached; pebbles up to 1" across; weak granular structure (A/B horizon of Sangamon Geosol developed in Pearl Formation)

6.8 - 8.7 ft Brown (7.5YR 4/4 to 3/4) clay loam to silty clay loam diamicton; common "ghosts" of carbonate clasts as much as 2.5" across; hard; medium to large blocky structure; leached; small, soft reddish (7.5YR 5/6) concretions (Bt horizon of Sangamon Geosol developed in Pearl Formation)

8.7 - 9.9 ft Brown (10YR 4/3) loam diamicton with geogenic layers that pinch and swell to about 1 inch thick; no ghosts as above; leached; small, soft reddish (7.5YR 5/6) concretions (upper C1 horizon of Sangamon Geosol developed in Pearl Formation)

9.9 - 10.0 ft Black layer about 1 inch thick demarcating leached from unleached material (lower C1 horizon of Sangamon Geosol developed in Pearl Formation)

10.0 - 12.9 ft Light olive brown (1Y 5/4) pebbly to cobbly sandy loam diamicton; calcareous; cobbles as much as 1 ft across; somewhat firm; only somewhat matrix supported (C3g horizon of Sangamon Geosol developed in diamicton facies of Pearl Formation)

12.9 - 13.6 ft Cemented gravel (Ck horizon of Sangamon Geosol developed in diamicton facies of Pearl Fm)

13.6 - 16.0+ ft Cobbly, bouldery sand and gravel; abundant flaggy, imbricated dolomite clasts (PROXIMAL OUTWASH; Pearl Formation). This unit is dredged at the Feltes pit, and nearby at the Prairie pit, to depths of about 65 ft.

Described by Brandon Curry and David Grimley, May 1998

Figure 18 Description of the Sangamon and Farmdale Geosols and associated lithostratigraphic units at the Feltes sand and gravel pit. Approximately 30 feet of Henry Formation sands and overlying 3 feet of Peoria Silt have been removed by mining.

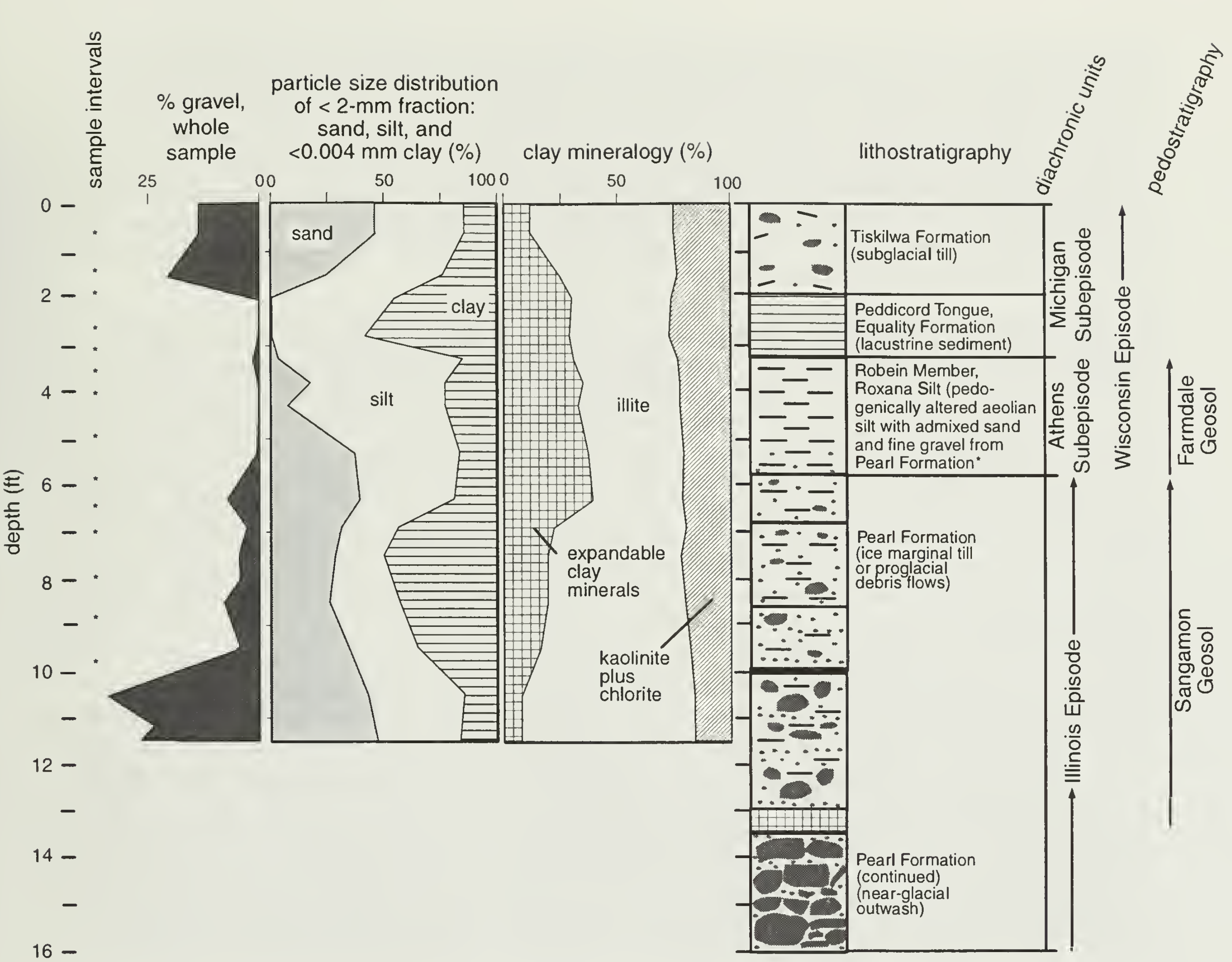


Figure 19 Particle size distribution, clay mineralogy, and stratigraphy of units described in figure 17.

angular clasts are flaggy blocks of Silurian dolostone. On the basis of 185 pebble- to cobble-sized clasts, we determined that the lithology of the Pearl Formation includes dolostone (79%), with less gabbro (9.0%), basalt (3.8%), granite (3.2%), ironstone (3.2%), quartzite (2.7%), chert (2.2%), and unknown sedimentary lithologies (1.1%).

We attribute the loam diamicton to debris flow, and the bouldery sand to outwash deposited in ice-marginal and proglacial environments during the last Illinois Episode advance of the Lake Michigan Lobe into Kane County. Nearby ice is indicated by the abundance of angular, boulder-sized clasts of Silurian dolostone in the sorted sediment. Some clasts exhibit very little abrasion and are interpreted to have been plucked from nearby underlying bedrock. The texture and clay mineral composition of the diamicton suggest association with the Oregon Till Member of the Glasford Formation (Berg et al. 1985, Curry et al., in prep.).

Sangamon Geosol A very poorly drained pedofacies of the Sangamon Geosol occurs in the diamicton and sorted sediment of the Pearl Formation at the Feltes pit (figs. 18 and 19); only the lower part of the oxidized C horizon that developed in sorted sediment of the Pearl Formation occurs at the Prairie pit. The solum of the Sangamon Geosol, rarely observed in cores or outcrops in this part of Illinois, is 1 foot thick. The reddish brown to yellow color of the Sangamon at these sites is likely due to diagenetic, bacterially mediated oxidation of soluble iron. Careful inspection of the Bt horizon reveals an upper subhorizon with thin, discontinuous argillans and medium, subangular to angular blocky structure and a lower subhorizon with coarse, blocky structure and gleyed ped cores. Other evidence of poorly drained conditions includes sesquioxide concretions as much as 2 mm across and a clay mineral composition dominated by smectite. Better-drained soil horizons that developed in Lake Michigan Lobe sediment have thicker Bt horizons; medium, sub-angular blocky structure; thick, continuous argillans; few concretions; and a clay mineralogy with less smectite and abundant randomly interstratified kaolinite and smectite (Curry 1989).

Robein Member, Roxana Silt; Farmdale Geosol The Sangamon Geosol is overlain by 2.5 feet of leached silt loam and organic-rich silt loam with rare *in situ* spruce stumps. The texture of this unit fines upwards, losing sand and gaining silt. The material often contains silans (silt coatings), fine biopores, and silt-lined root channels in the upper 0.5 foot. The clay mineralogy is dominated by vermiculite, a phase that was probably formed in the soil. Radiocarbon ages on spruce stumps rooted in the organic-rich silt include 24,000 ± 390 (ISGS-2108), 24,360 ± 430 (ISGS-1830), 24,670 ± 220 (ISGS-3982), and 25,820 ± 310 yr B.P. (ISGS-4055). These ages are similar to the youngest ages determined on *in situ* wood buried by tills of the last glaciation elsewhere in northeastern Illinois (Wickham et al. 1988, Curry 1989, Hansel and Johnson 1996, Curry and Pavich 1996, Curry, unpublished data). This layer correlates with the Robein Member of the Roxana Silt and its associated Farmdale Geosol.

Peddicord Tongue, Equality Formation As the glacier approached the Elburn area, a proglacial lake deposited about 1.6 feet of silt and clay and inundated the soil, which had supported the growth of trees and moss. Thriving in the lake were the fingernail clam *Pisidium ferrugineum* and cryophyllic ostracodes, including *Cytherissa lacustris*, *Limnocythere friabilis*, *Heterocypris* cf. *incongruens* (species also identified in the Equality Formation at the Fox River Stone quarry). Fragile fingernail clam and ostracode shells, however, are generally absent at either the Feltes or Prairie pits, due either to a fast sediment accumulation rate or comminution by shearing of the overriding ice. A wood fragment from this unit had an age of 28,180 ± 1,000 yr B.P. (ISGS-1799), which indicates it was reworked from the Robein Member. Proglacial lacustrine sediment buried by glacigenic sediment of the Tiskilwa Formation is classified with the Peddicord Tongue of the Equality Formation (fig. 5b).

Tiskilwa Formation As much as 30 feet of reddish brown loam diamicton overlies the lake sediment and buried soil complex. In some areas, the diamicton contains inclusions of organic silt (Robein Member) as large as about 30 feet long and 5 feet thick. The geometry of the inclusions and the nature of their contacts with the diamicton indicates the diamicton behaved as shearing elastic material or plastic-viscous material. The organic silt is interpreted to have been entrained by freeze-on to the glacier sole, transported, and deposited by meltout subsequent to some basal ice deformation. Given the degree of shearing and deformation present, it is not surprising that fossil preservation is poor in the proglacial Peddicord lacustrine sediment.

The succession of proglacial lake sediment overlain by diamicton from the last glaciation is consistent with an interpretation that once the Lake Michigan Lobe advanced into Kane County during the Marengo Phase (and formed the Marengo Moraine), it did not melt back prior to readvancing during the Shelby Phase, when the Bloomington Morainic System was formed (fig. 6). Evidence for this view includes the absence of a sediment sequence indicative of ice retreat and readvance, unidirectional east–west prolate pebble fabrics in Tiskilwa diamicton at the Feltes pit, and the absence of radiocarbon ages in Kane County from 23,000 to 20,000 yr B.P (which is consistent with the age of formation of the Bloomington Morainic System; fig. 6).

Henry Formation Forming the uplands west of Blackberry Creek is about 30 feet of well-sorted, planar to cross-bedded medium to fine sand (Henry Formation). This unit is capped by about 3 feet of stratified to uniform silt loam to silty clay loam (Peoria Silt). The upland was formed by a fan-delta associated with deposition of the Kaneville esker during the latter part of the Putnam Phase at about 17,500 yr B.P. (figs. 6 and 8). The esker and fan deposits post-date formation of the Arlington Moraine, located about 5 miles north of the Feltes pit, and likely are concurrent with other ice-stagnation landforms in the area such as Johnson's Mound and Bald Knob. The diamicton associated with the Putnam Phase, the Batestown Member of the Lemont Formation, has not been observed in the Feltes pit. Paleoflow in the esker was to the northwest according to the dip of channelized sands (Lukert and Winters 1965, Gross 1969). Along with the thick Henry gravels and sands in northeastern Kane County, the fan is the most intensively mined area in the county.

The Henry Formation fines north and west away from the ancient sediment source, the Kaneville esker. To the northwest, the sandy upland deposits are in facies relationship with laminated muds of the Equality Formation that abut the hummocky topography of the Arlington Moraine. These relationships are readily recognized on the air photos (see front cover).

25.9 Return to Route 47.

26.2 TURN RIGHT on Route 47.

26.8 TURN RIGHT on Main Street.

26.9 TURN LEFT into Blackberry Tavern Parking Lot. **Lunch Stop: Blackberry Inn** (Home of the Belly Buster Burger). After lunch, we will walk to our next stop at the Fisherman's Inn, visible to the southwest at the intersection of Main Street and Route 47.

STOP 4: FISHERMAN'S INN—*Matthew Barner and Michael Guebert*

The Fisherman's Inn restaurant is located near several artesian wells and small springs on the bank of Blackberry Creek (fig. 20). Several spring-fed ponds hold trout for the restaurant. In early 1997, Wheaton College volunteered an undergraduate research project to delineate the recharge area of the springs and wells for spring-head protection. The primary objectives were measuring, recording, and correlating fluctuations of rainfall, spring and well discharges, and regional groundater levels.

During the first year of monitoring (beginning May 1997), the discharge of two springs varied little from 0.3 and 0.8 gallons per minute (gpm). Three artesian wells flowed at annual averages of 2, 4, and 7 gpm, with less than 3 gpm annual variation. Depths to water in seven nearby private wells ranged from 12 to 65 feet, depending on topography (738 to 750 feet elevation), with annual fluctuations of less than 3 feet. Fluctuations in spring and well discharges and in groundwater levels correlate with seasonal climate change, with maximum levels in mid-summer and minimum levels in December.

Correlation of materials described in several water well logs (ISGS, open file) with the succession at the Feltes pit (Stop 3) indicates there are two unconfined, hydraulically connected units. The lower unconfined aquifer includes more than 100 feet of sand and gravel of the Pearl Formation, and the surficial aquifer is sand of the Henry Formation (fig. 20). The unconfined aquifers are separated by discontinuous deposits of the Tiskilwa Formation and other fine-grained deposits observed at the Feltes and Prairie pits. Most water wells in the area utilize groundwater from the lower unconfined aquifer.

A water-table map constructed from water levels in the seven local wells shows an eastward groundwater flow at a low gradient (4 feet per mile) in the upland and increasing gradient near the regional discharge area of Blackberry Creek (fig. 20). Blackberry Creek flows south in a valley broadly incised about 80 feet into the adjacent uplands. Several gravity springs occur on the valley

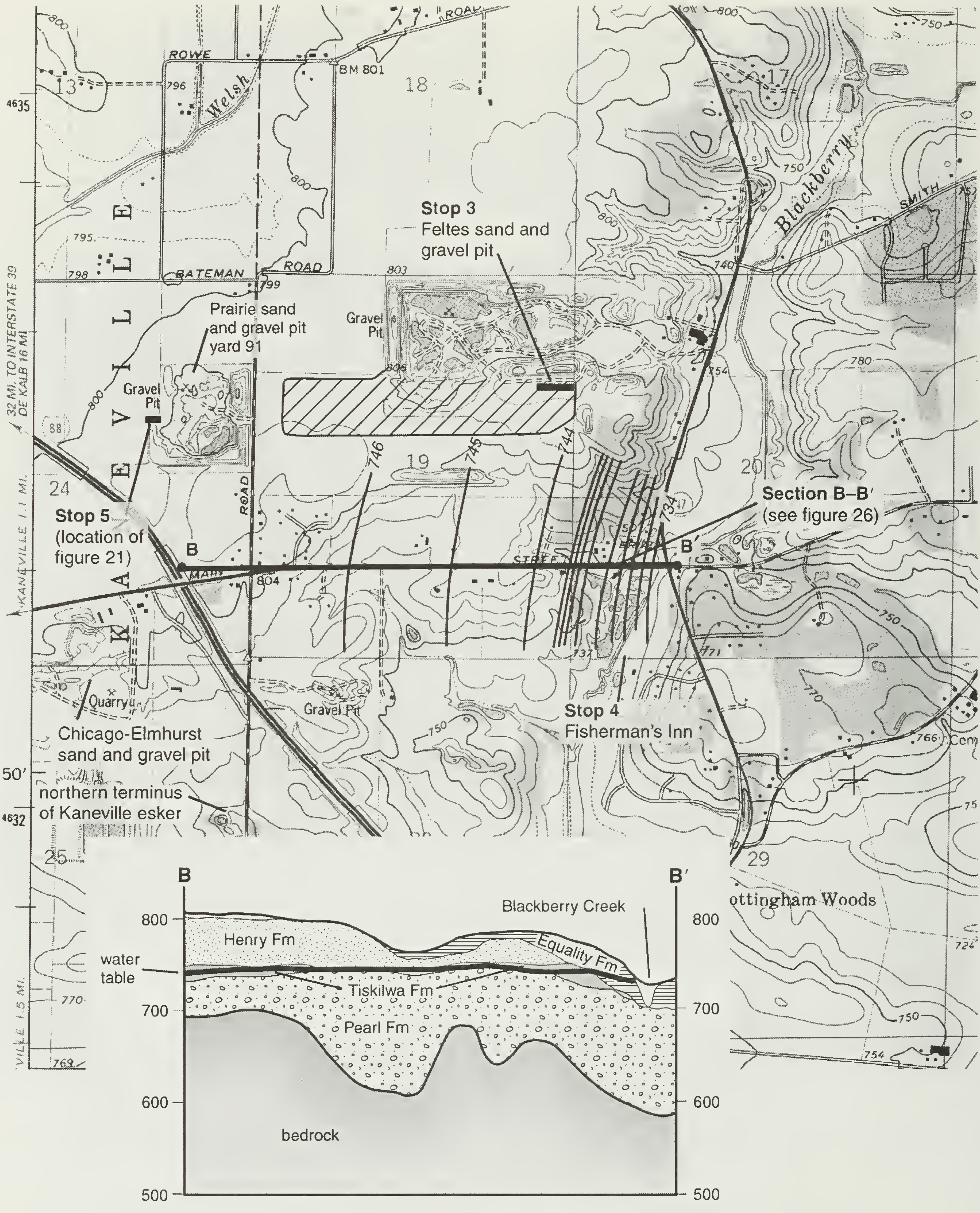


Figure 20 Portion of the Sugar Grove 7.5-minute quadrangle showing the line of cross section, cross section B–B′, Stop 3 (the Feltes pit), lunch stop, Stop 4 (Fisherman's Inn), and Stop 5 (Prairie pit). Also shown is the water-table elevation.

hillslope near the creek. Artesian conditions are induced in the wells used by the Fisherman's Inn because of the the upward flow of the Blackberry Creek discharge zone. The recharge area of the springs extends approximately 2 miles to the west of Blackberry Creek.

In March 1997, the Chicago-Elmhurst Company began to dewater sand and gravel in a pit 1.5 miles west of Fisherman's Inn (fig. 20). Public concern over lowered water levels in wells and ponds initiated intense public dialogue between citizens and consultants for the Chicago-Elmhurst Company. Pumping was discontinued in December 1997 at the same time that recovery (seasonal ?) began in local water levels. Pumping was not resumed as planned in 1998. Students at Wheaton College, in cooperation with the consultants, are continuing to monitor spring and well discharges and groundwater levels to better define the recharge area of the springs and to understand the magnitude of the impact of quarry dewatering on local groundwater conditions.

26.9 TURN LEFT on Main Street. The mounds north of Main Street are spoil from Feltes pit.

27.9 TURN RIGHT on Lorang Road. To the right are more spoil piles from the Feltes pit.

28.5 TURN LEFT into entrance to the Prairie pit.

STOP 5: PRAIRIE SAND AND GRAVEL PIT YARD 91—*Jay Stravers, Kathi Hibben, Brandon Curry, and David Grimley*

The stratigraphic succession at Prairie Sand and Gravel Pit Yard 91 is similar to that at the Feltes pit. We are visiting this location to observe some unusual sedimentary and clay mineral facies of the Tiskilwa Formation (figs. 21 and 22) and a succession of surficial sand and gravel (Henry Formation). The Praire pit is located near the northern terminus of the Kaneville esker (fig. 20), and hence, sorted sediment of the Henry Formation is, in general, coarser grained than in the Feltes pit. Four lithologic units were identified along an east–west-trending highwall on the west side of the pit.

Lithostratigraphic Units

Tiskilwa Formation Starting at the base of the section, unit 1 is composed of more than 6 feet of uniform to stratified loam diamicton that contains abundant carbonate clasts; thin, continuous layers of yellowish sand and fine gravel impart the stratification. Diamicton clay mineralogy (illite content of about 65%) and texture (sand content of about 44%; fig. 22) are similar to that of the Tiskilwa diamicton at the Feltes pit. In places, the diamicton rests on oxidized, gravelly sands of the Pearl Formation that are interpreted to be the C3 horizon of the Sangamon Geosol. Evidence such as a weak prolate pebble fabric (azimuth = 99°; dip = 12°; S1 = 0.68) suggests that the diamicton was a proglacial debris flow that moved northwest into a low-lying area that had been stripped of the solum of the Sangamon Geosol (fig. 21).

Unit 2 is composed of 4 feet or less of sorted sediment that includes a gravelly lag (fig. 21). Clast lithology is strikingly different from that of the Pearl Formation, with many fewer clasts composed of carbonate and more clasts with Canadian Shield provenance.

Unit 3 is composed of coarsening-upward gray (5Y 4/1) silty clay, gray (5Y 6/1) silty clay diamicton, and brown (7.5YR 5/4) loam diamicton (figs. 21 and 22). Contacts among the materials are gradational. Like unit 1 below, the diamicton contains numerous sand stringers. The grayer the sediment, the higher the illite content (fig. 22). In the diamicton, we measured another weak prolate pebble fabric with an azimuth of 326° and dip of 2° with an S1 value of 0.74. We attribute the stratified basal muds of unit 3 to a near-glacial lacustrine environment that was later buried by debris flows. The underlying discontinuous sand layer (unit 2) is probably channelized outwash deposited between

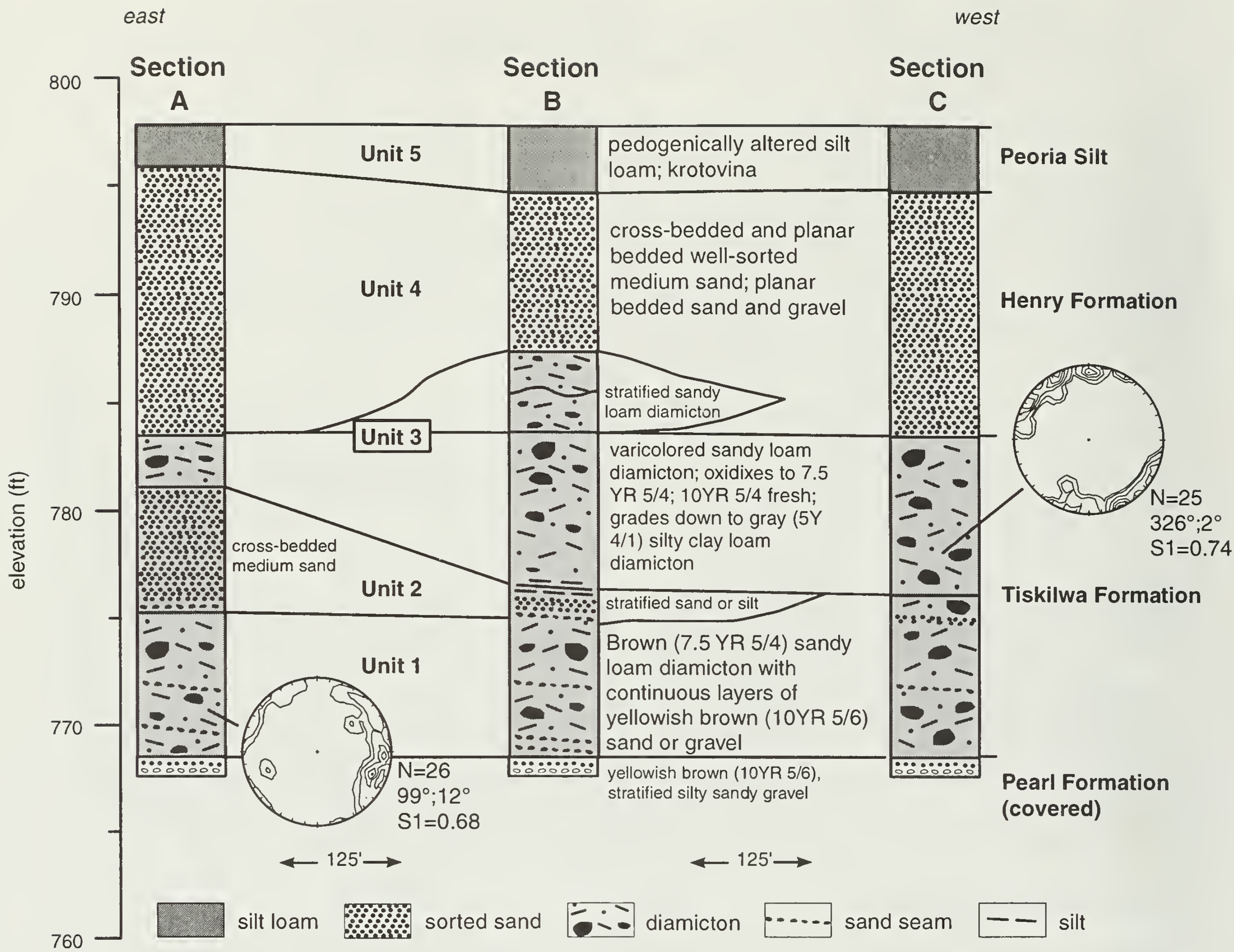


Figure 21 Pebble fabrics and lithofacies logs of three sections measured at the Prairie pit (Stop 5).

debris flow events. The origin of the illite-rich sediment is puzzling. One explanation might be that the glacier locally eroded and entrained an Illinois Episode illite-rich deposit; illitic diamictons, however, are not present in the region (ISGS, open file). Another explanation might be that the gray illite-rich sediment was derived from local entrainment and comminution of Paleozoic shales.

Henry Formation Unit 4 is composed of about 10 to 20 feet of cross-ripple drift sand and planar to trough, cross-bedded medium sand and gravel of the Henry Formation (fig. 21). Foreset and topset beds are common in unit 4; foreset beds dip to the northwest, which is consistent with the interpretation of Lukert and Winters (1965) of paleoflow direction associated with the Kaneville esker. Similar features have been noted at the Feltes pit, but the surficial sands are typically finer grained than at the Prairie pit. Thickening and fining to the north, unit 4 is probably a fan-delta deposit associated with formation of the Kaneville esker during the Putnam Phase (figs. 6 and 8).

Peoria Silt Unit 5, about 2.5 feet thick, is composed of pedogenically altered silt loam of the Peoria Silt (fig. 21). Initially an aeolian deposit, the surficial silty sediment has been thoroughly burrowed and consumed by soil organisms, notably earthworms and crayfish.

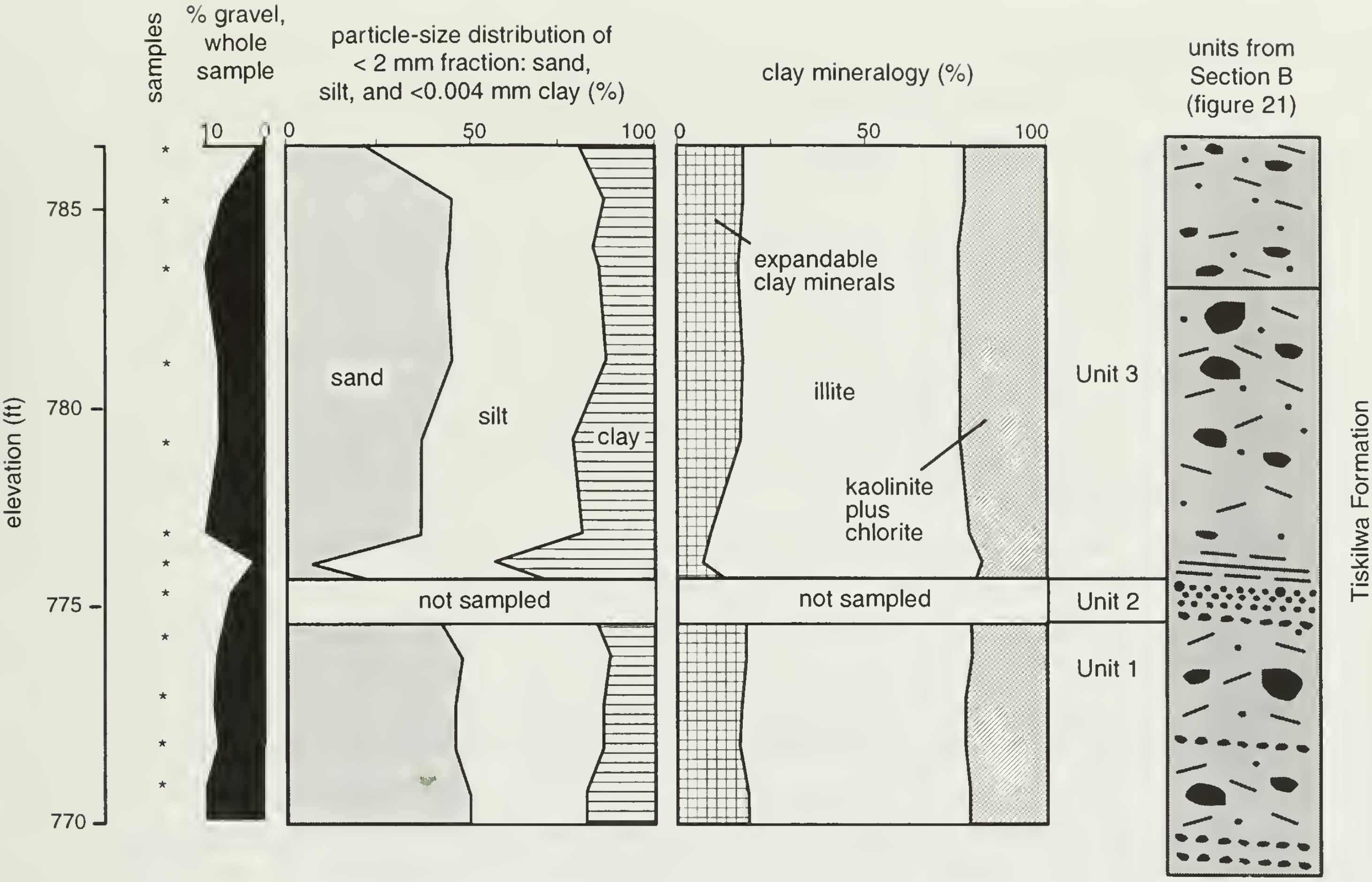


Figure 22 Particle size and clay mineral data of units from Section B (fig. 21) at the Prairie pit (Stop 5).

28.5 TURN RIGHT on Lorang Road.

29.1 TURN LEFT on Main Street.

30.2 TURN LEFT onto Route 47; proceed north.

33.6 Pass through village of Elburn.

37.2 Rising onto the Marengo Moraine, which is composed of diamicton and some sorted sediment of the Tiskilwa Formation. This is the oldest Wisconsin Episode end moraine in Illinois (fig. 11).

38.6 On the right is a farm house where Frank Leverett logged a water well hole in the late 1800s (Leverett 1899, p. 294).

39.3 TURN RIGHT on Silver Glen Road. Drive across southern end of Glacial Lake Pingree, an ice marginal lake formed during the Putnam Phase (fig. 12).

41.5 TURN RIGHT on Burlington Road.

44.9 On the right is a sand and gravel pit, the type section of the Wasco Member of the Henry Formation as defined by Willman and Frye (1970).

45.2 TURN LEFT on Route 64 and proceed east back to the Super 8 Motel.

50.1 The trip now ends in St. Charles. Load off the buses and remember your field supplies and samples. Thanks for joining us on the trip! We hope you enjoyed it.

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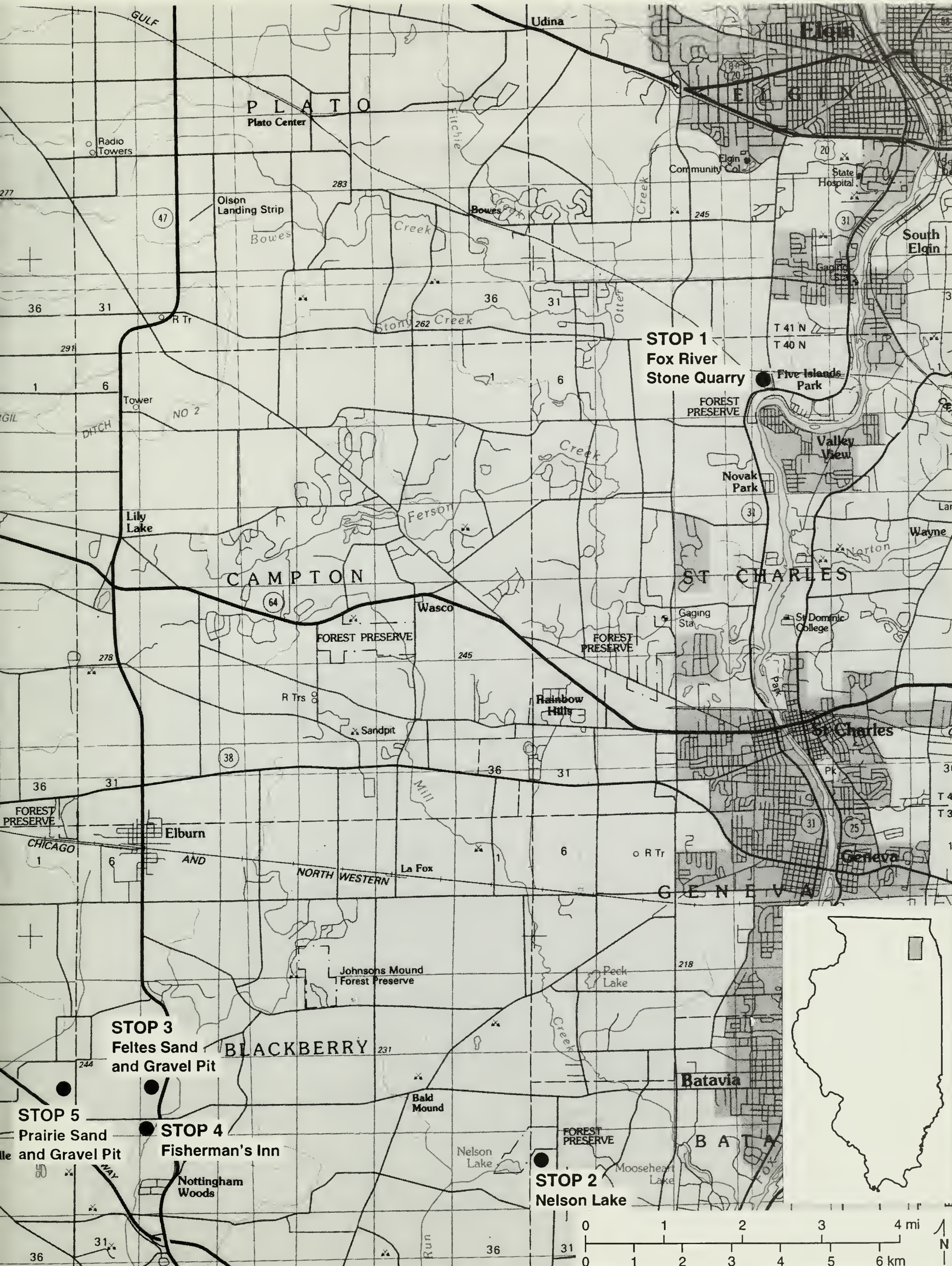

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STOP 2
Nelson Lake
STOP 3
Feltes Sand
and Gravel Pit
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Fisherman's Inn
STOP 5
Prairie Sand
and Gravel Pit
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Elgin
ELGIN
PLATO
Plato Center
Radio Towers
Olson Landing Strip
Bowes
Elgin Community Col
State Hospital
South Elgin
Five Islands Park
FOREST PRESERVE
Valley View
Novak Park
Lily Lake
CAMPTON
Wasco
ST CHARLES
St Dominic College
Wayne
Rainbow Hills
Sandpit
St Charles
Elburn
La Fox
CHICAGO AND NORTH WESTERN
GENEVA
Geneva
Johnsons Mound Forest Preserve
BLACKBERRY
Bald Mound
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